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Logistic management model for food loss reduction in East African food value networks

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1 Introduction

Providing people with food is a major challenge in many ways. The challenges associated with it will become even more important in the future considering the continuously growing world population. While resources for food production are limited, the Food and Agriculture Organisation (FAO) of the United Nations (UN) estimates that approximately one third of the produced food does not reach the consumer (Gustavsson et al. 2011). Lost food is not only a problem because it cannot be used to feed people who need it, but because it also involves a considerable waste of resources (FAO 2017a). The current amount of food waste would meet the calorie requirements of 1.9 billion people. In addition, according to UN statistics around 815 million people worldwide are currently suffering from hunger (UNITED NATIONS 2015b). Hence it is generally concluded that the food supply worldwide does not have a production problem, but a distribution problem. This is one of the core functions of logistics and should therefore be addressed by this discipline (Hiç et al. 2016; Pfohl and Feldkamp 2001).

The food industry, for example in Europe, with approximately 4.2 million jobs and a turnover of around € 1,048 billion (in Germany approximately € 175.2 billion), is one of the largest economic sectors (Bücking and Hengse 2018). In many developing countries, the food industry occupies an even more important position. In African countries, an average of two-thirds of the population is employed in this sector. Approximately 23 percent of the continent's gross domestic product is generated by agricultural products. This sector is thus by far the most important economic sector in Africa. Considering the background of hunger and malnutrition on the continent, this factor is further underlined (BMEL 2020). Accordingly, it is of particular relevance for industry, consumers, experts, and research institutions to handle food losses. Logistics concepts such as innovative technologies and process optimization along the food value networks should help to reduce food losses.

The problem of food losses is not a new phenomenon. However, it has not been in the public spotlight for a long time. This has changed through various initiatives in recent years. As a result, the issue has also found its way into the UN's 17 global sustainable development goals. The 12th objective "responsible consumption" includes the following sub-objective 12.3:"By 2030, halving per capita global food waste at retail and consumer

level and reduce food losses along the production and supply chain, including post-harvest losses." (UNITED NATIONS 2015a) The objective directly addresses the core functions of logistics and thus represents an immanent task for logistics industry and science.

Logistics can make a significant contribution to reducing the losses of produced food through appropriate logistical measures. Thus, specific concepts are developed for individual parts of food value networks or for certain types of food, which contribute to the reduction of losses in the context of logistics.

However, current research concepts on food losses prevention in the context of logistics mainly focus on the downstream stages of food value networks. Hardly any methods are discussed that allow a holistic view from the beginning of food production to the end customer. Current research driven by industrialized countries is predominantly concerned with high-tech approaches, such as RFID sensors, smart containers or decision support systems (Borit and Santos 2015; Chuang et al. 2017; Pinior et al. 2015).

In industrialized countries, the losses are largely caused at the end of the value network on the consumer level. In developing countries, however, according to FAO reports by Gustavsson, losses are mainly recorded in the early stages of the value network (Gustavsson et al. 2011). Due to its rapidly growing population, which is expected to double by 2050, Africa is attracting attention in this context (UN DESA 2018). A low level of logistics structures and the lack of process knowledge, for example, are some of the causes for this situation. In recent years, logistics experts in developing countries have focused primarily on improving logistics in the event of a disaster (humanitarian logistics). Much less attention was put into improving the regular value networks and the development of logistics structures that benefit the regional economy (Schwarz 2012). Addressing the question of “How low-loss food value creation can be achieved through improved logistics structures in Africa?” thus becomes an urgent necessity (Blome 2016).

The problem of the growing population in Africa is connected with the low economic development in African countries and is therefore a big challenge. In connection with the problem of food losses, the current situation urgently calls for solutions that not only enable the efficient handling of food in African value creation networks, but also increase

the economic success of companies. On the one hand, the increase in economic efficiency contributes to the fact that, for example, more personnel can be hired due to new or increased sales opportunities. On the other hand, it enables an increase in purchasing power and thus contributes to the positive economic development of the respective countries. Logistics, by its very nature as a process and efficiency-oriented discipline, has great potential within this framework to contribute to improving the situation described (BMWi 2017).

The region of East Africa is of particular relevance in this context, especially with regard to the distribution of expected population growth and current economic developments. For example, Ethiopia is planning to become a middle-income country by 2025 and Kenya has already left behind the status of a low income country (World Bank 2019). The associated efforts to increase efficiency and output potential must be linked to resource-efficient management (Federal Democratic Republic of Ethiopia 2016; The Federal Democratic Republic of Ethiopia 2010).

The economies of the East African countries are heavily dependent on agriculture. Local consumption is based on corn, rice, millet and cassava (Sarris and Morrison 2010). But also, regarding agricultural export products, mainly plant products such as coffee, fruits and vegetables are found. These plant products are particularly significant in terms of food losses. For example, in the fruit and vegetable category, losses rate of up to 40 percent are assumed in the food value networks (Gustavsson et al. 2011). In this context, the optimization of logistical processes in this sector has a particularly high potential to benefit the entire economic system of a country (Hesse and Jánszky 2014). It has been shown in several project examples that the strengthening of smallholders from subsistence farming to commercial agriculture leads to the formation of further economic structures around these farms (Arias Bustos and Moors 2018; Despoudi et al. 2018; Lutz et al. 2017; Markelova and Mwangi 2010).

In addition to the specific issue of the efficient use of food and the resources required for its production, the general question of resource-efficient economic activities is at the centre of public debate in today's society (Gustavsson et al. 2011; FAO 2017a). Thus, logistics and logistics science must address with the question of how resource efficiency can be implemented as an integral part of logistics thinking and action.

1.1 Research objective and outline of the dissertation

The dissertation is concerned with the reduction of food losses in food value networks. In particular, it is concerned with reducing food losses that can be localized within the system boundaries between the agricultural level in East African countries and the point of sale of these products in East Africa or the point of export of these products in these countries. Losses that occur in industrialized countries up to the point of sale are not included in the scope of the study.

The aim of the dissertation is to develop a logistic management model, which supports organizations in East African food value networks to develop logistical measures for the reduction of food losses. It is to be considered that an individual solution strategy can be developed based on the organization and its specific conditions. In particular, the conditions in East African countries will be considered.

This results in main the research questions (PRQ) for the dissertation:

PRQ1: How can organizations operating in East Africa be enabled to independently develop solutions for eliminating causes of food losses and increase the economic viability of their companies with these measures?

PRQ2: How can a logistic management model be designed to help organizations in East African food value networks reduce food losses through logistical measures?

In order to answer these questions, the following three secondary research questions (SRQ) will be addressed:

SRQ1: Which criteria are set as objective parameters when developing logistics measures against food losses?

SRQ2: How can companies be supported in determining their own level of readiness regarding the topic of food losses to be able to independently develop solutions for their own context?

SRQ3: How can organisations of food value networks be differentiated in terms of their readiness levels regarding the implementation of food loss reduction management in logistics and how can this distinction be used to derive recommendations for

action for the future implementation of food loss reduction management in logistics?

Based on the research questions, the dissertation is structured into the introduction, the theoretical foundations, three scientific articles and the model development with subsequent reflection on the basis of case studies, followed by the summary. Following the introduction, the theoretical foundations of this dissertation are described and the framework for the current scientific status of food losses is given. Afterwards, a closer look is taken at the study region of East Africa and food value networks located in this region. The first scientific article, presented in chapter 3, addresses the research question SRQ1 and systematizes measures against food loss. For this purpose, a systematic literature review is conducted in combination with expert interviews. The second article, presented in chapter 4, answers research question SRQ2 and develops a readiness assessment tool that captures the current state of food value network organizations. An online survey is conducted for this purpose. The third article, presented in chapter 5, answers research question SRQ3 and, based on the readiness assessment tool from the second article, derives profiles that describe how organizations deal with food loss reduction management. This article is also methodologically based on an online survey. After the three articles, the first primary research question is answered. The second primary research question is answered in the model development. Here, together with the previous findings of the dissertation and based on the research theory of integrated business ethics, the intended logistic management model is developed and subsequently reflected upon using 18 feedback interviews and other available information. In the Overall summary and outlook section, the dissertation is summarized, and the dissertation is critically reflected and an outlook on further research needs is given. The structure of this dissertation can be seen in **Figure 1**.

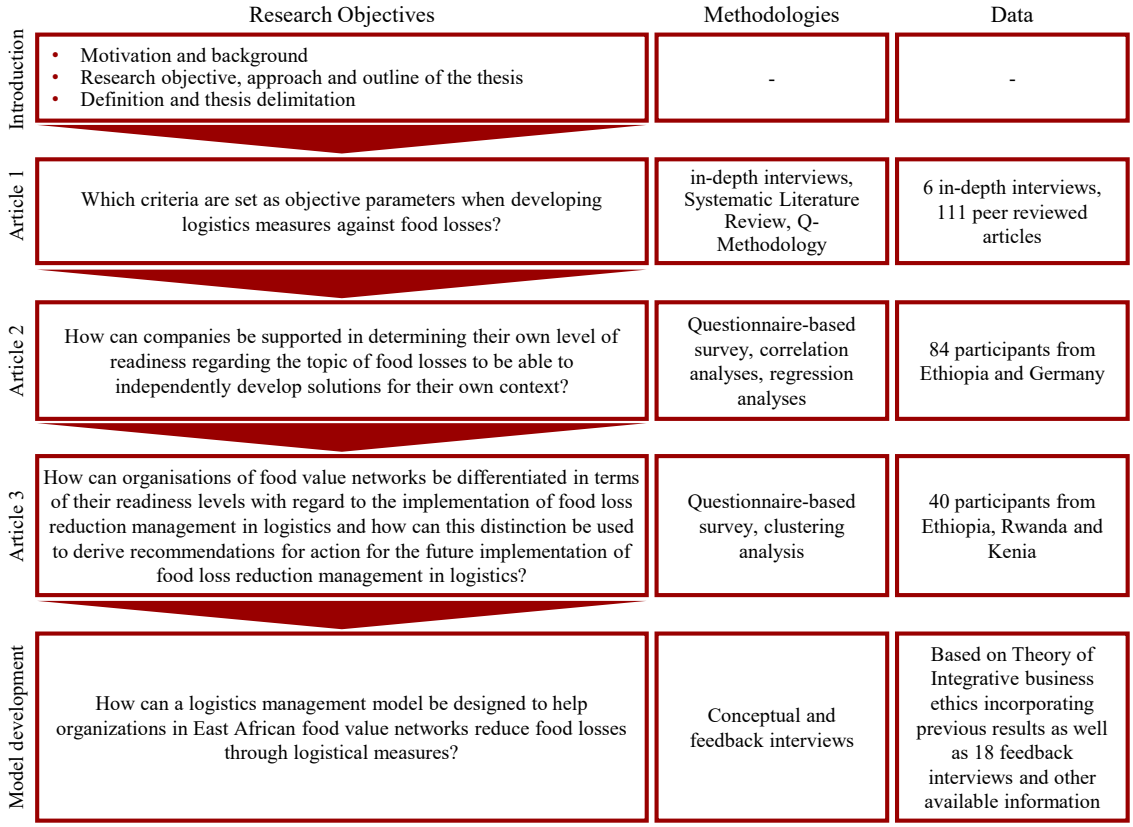

Figure 1 - Structure of the dissertation

1.2 Delimitation

In the following, the object of analysis and the area of analysis are presented in **Figure 2**. The characteristics considered in this dissertation are marked in dark red. Striped marked characteristics are partly in the focus of this dissertation.

Category	Manifestation							
regional focus	**Developing countries**				Developed countries			
Level of analysis	Function	**Firm**		Dyad		Chain	**Network**	
Examination level	Harvesting	**Post-harvesting**	**Trans-portation**	**Warehousing**	**Processing**	**Packaging**	**Retailing**	Households
Function	Farmer	**Logistics Service Provider**	**Manufacturer**	**Export and import companies**	**Retailer**	Technology Service Provider	Consulting	Others
levels of losses	Un-avoidable losses		**Avoidable losses**			Wastage by end consumer		
Hierarchy of losses	**Avoidance**	**Reutilization**		**Recycling**		Recovery	Disposal	

Figure 2 - Derivation of the object of investigation

This dissertation examines processes in developing countries, specifically food producing countries in East Africa at various levels of value networks. A main focus is on the countries of Ethiopia, Tanzania, Kenya, and Rwanda, since it was within these countries that the dissertation data collection was made possible. However, other East African countries will also be considered if sufficient information is available. The focus of this dissertation is on food value network organizations as the object of analysis. However, individual companies or organizations as well as entire networks are considered as the level of analysis. The processes to be analysed are mainly carried out on the organizational level. However, the focus is also on cooperative processes between organizations, which is why the level of analysis is also at the network level. Post-harvest processes, transportation, warehousing, packaging, and retailing are examined. The food value networks stages of harvesting, processing, and the customer level are not prioritized in this work because the impact of logistical measures to reduce food losses in these areas is very small or non-existent. The production level is only considered as far as it is included in holistic strategies and production logistics is applied here. Based on this, all types of companies that are involved in logistics processes are considered. Specifically,

logistics service providers, manufacturers, export and import companies and traders are focused on. It is noted that East Africa is this classification is not necessarily limited to companies with a profit motive. For example, non-governmental organizations (NGOs) act as retailers or service providers for governments in distributing food to the population. For this reason, organizations are considered in this dissertation solely according to the types of functions mentioned above, and not according to their general purpose. For example, if the World Food Program (WFP) is involved in the storage and distribution of food in Ethiopia, they are considered service providers for the purposes of this dissertation. Thus, the focus is on the performance of function in the context of this work. Three types of losses are distinguished: unavoidable losses, avoidable losses, and losses or wastage by the end user. In the context of this work, only the avoidable losses are considered and solutions for these types of losses are developed. In terms of hierarchical levels of loss prevention, the focus of this work is on avoidable losses. Reuse and recycling are also examined but are not the focus of this work. Strategies and measures for recovery and disposal are not the subject of this work.

2 Research design and conceptual background

The basis of this research work is a positivistic research view. From an ontological point of view, an objective and structured view of the world is assumed. With regards to epistemology, the view is taken that knowledge arises through the application of focused and structured methods and that this must be based on causal relationships and evaluable facts. With regards to axiology, a value-free research is pursued in which the researcher behaves neutrally and independently of the object of investigation (Saunders et al. 2016).

The thoughts and conclusions presented in this work are based on general scientific theories. On the one hand, these form the basic attitude of the scientist, and, on the other hand, they form the framework within which the research presented for this dissertation is conducted. The basic scientific theories used are presented below and their application in this research work is described.

2.1 Integrative business ethics

Integrative business ethics is used as the foundation for finding solutions as well as the perspective on the scientific design requirements of logistics. According to Ulrich, integrative business ethics defines a holistic view of the tasks and areas of responsibility of a business enterprise. As a guiding principle, Ulrich formulates the following points (Ulrich 2001):

- Criticism is levelled at "pure" economic reasoning
- Socio-economic rationality is postulated as the basic building block of economic action
- Public discourse is described as the principal "place" of morality (Ulrich 2001)

The critical approach should show that normativity is not to be understood as the negative side of economic rationality, but as its foundation. The challenges outlined by Ulrich are to turn against the economic shortenings and limiting circular inferences that result from pure economic rationality and its concepts and lead to a reflection on its inner rationality. In this way, economic rationality will become a modern approach to sustainability in all its three pillars, with the focus on economic thinking and action.

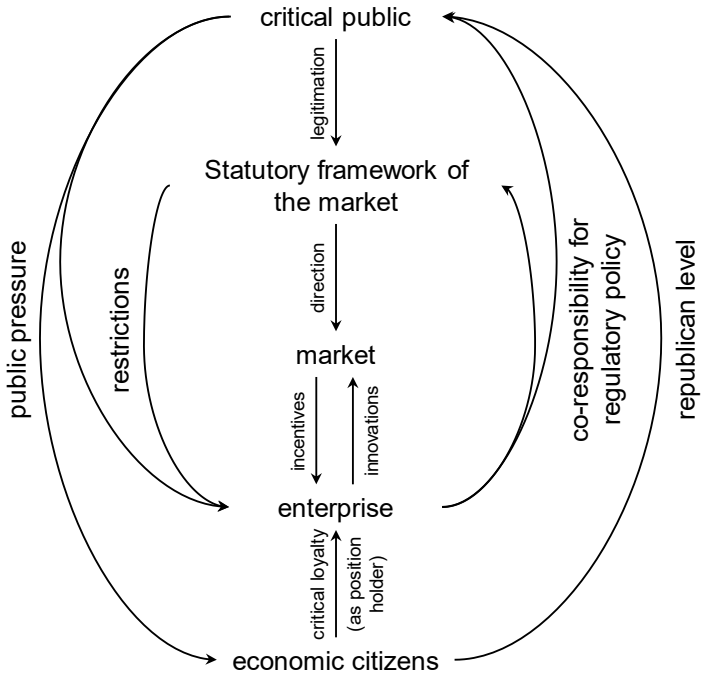

Figure 3 - Locations of the Moral of Economy (Ulrich 2001)

In dealing with the scarcity of resources and goods, it is not only economic rationality that provides a standard, but the social conflicts associated with it require an integrated normative solution. "The unconditional basic moral requirement, which claims validity as a normative condition for all reasonable action, is that of legitimacy, [...]" (Ulrich 2001). According to Ulrich, however, legitimacy can only be fulfilled if not only those directly affected but also those indirectly affected, and their interests are considered. The practical question does not end with the question of whether an action is efficient, but includes to whom the efficiency applies (Ulrich 2001).

According to Ulrich, only on the foundation of an economic ethic based on socio-economic rationality can a moral point of view be asserted. Integrative economic ethics opposes the neoclassical thinking of an independent economic calculus and poses the question of the purpose and claim of the serviceability of economic enterprise.

In the following section the theoretical background of this work is presented. The four most relevant terms logistics, food, food logistics and food losses are discussed.

2.2 Logistics

At the beginning of the 1990s, the holistic, flow-oriented approach of logistics replaced the cross-departmental optimization of process chains. The task of logistics was to achieve uniform coordination within the company by integrating several areas through simultaneous coordination. Above all, the focus was on the growing importance of information flows to be coordinated. The reduction of information deficits between and within process chains was regarded as an essential goal and function of logistics (Baumgarten et al. 2002; Straube 2004). The next step was to coordinate cross-company value networks to enable cross-company integration. This holistic view of the process chain allows an optimization of all stages of the value network, which should do justice, above all, to the growing importance of the factor "time". Overall, logistics not only integrates individual functions into company-internal process chains, but also companies into cross-company value networks. Logistics thereby becomes a management task that should achieve flow orientation in all physical, organizational and informational areas of companies (Baumgarten et al. 2002; Straube 2004; Pfohl 2018).

Since the end of the 1990s, the management of global corporate networks has moved to the forefront of logistics design. The cross-company optimization of value networks is already being implemented with reference to supply chain management. Today's understanding of logistics places the customer in the centre, who influences the entire value network with his expectations and also taking globalization into account (Baumgarten et al. 2002; Straube 2004; Pfohl 2018).

Therefore, the fundamental understanding of logistics in this work follows the definition of logistics according to Straube (2004):

> *"The basic task of logistics is the economical and on-time production, provision and delivery of goods, materials, products, and services ordered by customers. Logistics organizes processes, system structures and entire networks from increasingly globally distributed origins to globally distributed destinations."* (Straube 2004, p. 27)

Taking into account the theory of integrated business ethics on which this dissertation is based, companies are obliged not to use profitability as the only target criterion for their

own actions. Accordingly, it is postulated that companies also have to consider their benefit for the public welfare. The effects that a company has on the public welfare include its own continued existence and thus the preservation of the jobs created by the company as well as the added value of the products and services provided by the company. In addition, however, companies must also consider the effects on the environment that result from their actions. Effects on the environment and society that indirectly result from the company's actions also must be considered. Consequently, it can be summarized that companies are committed to a sustainable orientation in the classical sense, which must consider all three dimensions (ecological, economic, and social) equally. Accordingly, the basic definition of logistics in the context of this work must be expanded into sustainability:

> *"The basic task of logistics is the **sustainable** and on-time production, provision and delivery of goods, materials, products, and services ordered by customers. Logistics organizes processes, system structures and entire networks from increasingly globally distributed origins to globally distributed destinations."*

From this definition it is clear that the ultimate goal of logistics is to enable the customer order process to be fulfilled. **Figure 4** illustrates this linkage.

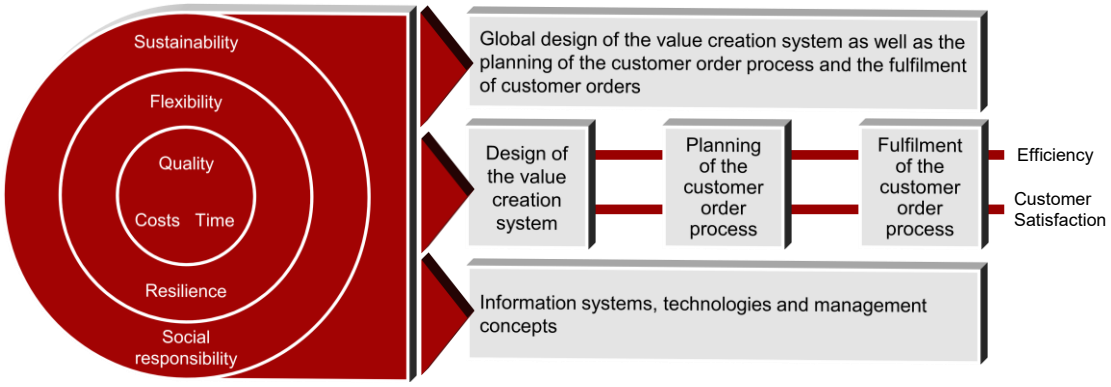

Figure 4 - Logistics regulatory framework according to Straube (2004)

As the figure shows, the core target variables of logistics are quality, costs, and time. In addition, logistics must be oriented towards the target variables of flexibility, resilience and sustainability, and thus social responsibility. This is done within global value-creation

networks. This holistic approach to understanding logistics particularly guides the focus of this work.

In the current international scientific discussion, there is a debate about the relationship between the terms logistics and supply chain management. Different perspectives on this relationship are represented and discussed. A study by Larson and Halldorsson (2004) has named the following descriptions for these perspectives:

Traditionalists see logistics as a holistic discipline that both handles internal company processes and crosses company boundaries. They regard supply chain management as a sub-discipline of logistics that describes external or cross-company parts of logistics.

The **relabelling approach** pursues the understanding that the concepts of logistics and supply chain management are identical and equate these terms. The term relabelling derives from the fact that many authors who represent this view use the term supply chain management as a modern term in order to use a new label for a well-established concept.

Unionists take the view that logistics concentrates exclusively on company-internal procedures and processes and is therefore to be classified as part of a comprehensive supply chain management concept. This view considers that logistics, marketing, operations management, sales, and other functional areas of business operations are part of supply chain management.

The group of **intersectionists** takes the view that logistics and supply chain management are two concepts that exist side by side, have certain overlapping areas of definition and thus address partly with the same questions.

Despite the study by Larson and Halldorsson (2004), this discussion is still ongoing, and the views presented can still be found in the scientific and practical discourse on the subject. For example, the German Logistics Association (BVL) as the largest national representative of the logistics industry has expressed the view on its website that the concepts of logistics and supply chain management are identical and that the terms are therefore used synonymously (BVL 2019).

According to the definition of logistics on which this work is based, logistics is understood as a discipline that transcends both internal and external company boundaries

and is also applied at a network level. This definition is also represented by the German Logistics Association. Consequently, the relabelling approach is also represented in this work and both terms are used synonymously. In contrast to the classical understanding of re-labelling, where the term supply chain management is used as the leading term, the term Logistics is used as the leading term in this work.

Logistics has gained in importance in the economy. Today, its positive contribution to social development is acknowledged and valued. In the context of this development, however, those managing logistics has also become aware of its own responsibility for society. In this context, for example, numerous publications in the field of humanitarian logistics have been published (Schulz 2009; Baumgarten and Blome 2014; Keßler 2012; Schwarz 2012; Blome 2016).

According to Baumgarten, **humanitarian logistics** is defined as "all processes associated with the planning, implementation and control of aid supplies, resources and personnel. In addition to the physical flows of food, medicines, water and water treatment plants, sanitary facilities, temporary accommodation, etc., this also includes the associated information and financial flows." (Baumgarten et al. 2010, p.452)

In the context of humanitarian logistics, which mainly covers with the logistics of disaster situations and aid organisations, it was also established that long-term meaningful development aid in the context of logistics must not be limited to disaster response (Blome 2016). The need for support for self-help in the form of strengthening local logistics structures must be made possible (The Federal Government of the Federal Republic of Germany 2017a; Afrika-Verein 2018; Yadav 2015). Local potentials can only be fully exploited if local forces are autonomous. This is an essential step towards moving away from a donor-recipient mentality and towards partnership between industrialised and developing countries. This aspect should be particularly emphasized with regard to the potential for cooperation between Europe and Africa (The Federal Government of the Federal Republic of Germany 2017b). This dissertation is also positioned in this spirit. It is a work that breaks away from the original approach of humanitarian logistics and rather follows the approach of classical logistics in the corporate context. The work brings together the spirit of modern humanitarian logistics and the approach of help for self-help as well as classical logistics in the corporate context.

2.3 Food logistics and food value networks in East Africa

Firstly, the term "food" must be defined in the context of this dissertation. According to the European Parliament and the European Council, food is defined as follows:

> *"[...] 'food' means any substance or product intended to be, or reasonably expected to be ingested by humans, whether processed, partially processed or unprocessed. Food also includes beverages, chewing gum and any substance, including water, intentionally added to the food during its manufacture, processing or alteration."* (European Parliament 2002)

Based on the above definition, the following products are not food:

- Animal feed
- Live animals, provided that they have not been prepared for human consumption
- Plants before harvest
- Medication
- Cosmetic products
- Tobacco and tobacco products
- Narcotics and psychotropic substances
- Residues and contamination (European Parliament 2002)

For this dissertation, the definition from the European Parliament and the European Council is used. Due to the special logistical requirements of the water supply, the supply of (unpacked) drinking water for example is not considered in this dissertation. The supply of bottled liquids (water, soft drinks, and juices) nevertheless is covered by the definition described above and is, thus, understood as part of the object of investigation of this work.

Logistics in the food sector is diverse and different stages are involved depending on the food concerned. Various authors have created a general definition of the stations in the food value networks (Gustavsson et al. 2011; Parfitt et al. 2010; Ting et al. 2014; FAO 2017b; UNITED NATIONS 2015b; Manners-Bell 2013; Yu and Nagurney 2012). This overlaps. However, they also differ in certain areas. Therefore, it is of high relevance to formulate the basic understanding of this work regarding a definition of the food value networks and to present the definition valid for this dissertation.

A leading definition of the food value networks comes from Gustavsson et al. (2011). It divides the food value networks into five stages (Gustavsson et al. 2011). Starting with agricultural production as the first stage, postharvest handling and storage are formulated as the second stage. The third stage is processing. In the fourth step, Gustavsson et al. formulate distribution, followed by the fifth and final step, consumption by the end consumer (Gustavsson et al. 2011). Furthermore, the literature contains the approach of Parfitt et al. which describes a more detailed structure and divides the food value network into eleven steps (Parfitt et al. 2010). In principle, however, these approaches are similar in their structure of the process. Parfitt et al. put harvesting in the first step, followed by threshing as the second and transport and distribution as the third step. Gustavsson's processing stage is divided into three stages: primary processing (e.g., cleaning, drying, packaging), secondary processing (e.g., mixing, cutting, cooking) and quality control. This is followed by the packaging stage and the marketing stage. Gustavsson's consumption stage is divided by Parfitt into the steps post-consumer and end of life (Parfitt et al. 2010).

Both approaches follow a process-oriented way of thinking. However, neither model considers regulatory processes and neither includes them in their frameworks. In this regard, the design approaches of Manners-Bell (2017) and Poppe (2017) provide a more broad view (Manners-Bell 2017; Poppe 2017). Both have an FSC actor-oriented perspective and thus complement the function of regulatory control on the food value networks by including governments and authorities as actors in the food value networks. In addition, in both cases at the consumer level there is a separation between the food value networks actors wholesale, retail and caterers (e.g. canteens, restaurants and delivery services) and the end consumer (Manners-Bell 2013).

Another weakness of the approaches presented is that fundamental logistical functions such as transport, storage and handling are placed at a fixed point in the networks. In real food value networks, however, these supporting functions can be found between all the steps mentioned. For this reason, based on the approaches presented as well as the additions mentioned, the structure of a food value networks shown in **Figure 5** is used as a foundation for the research presented here.

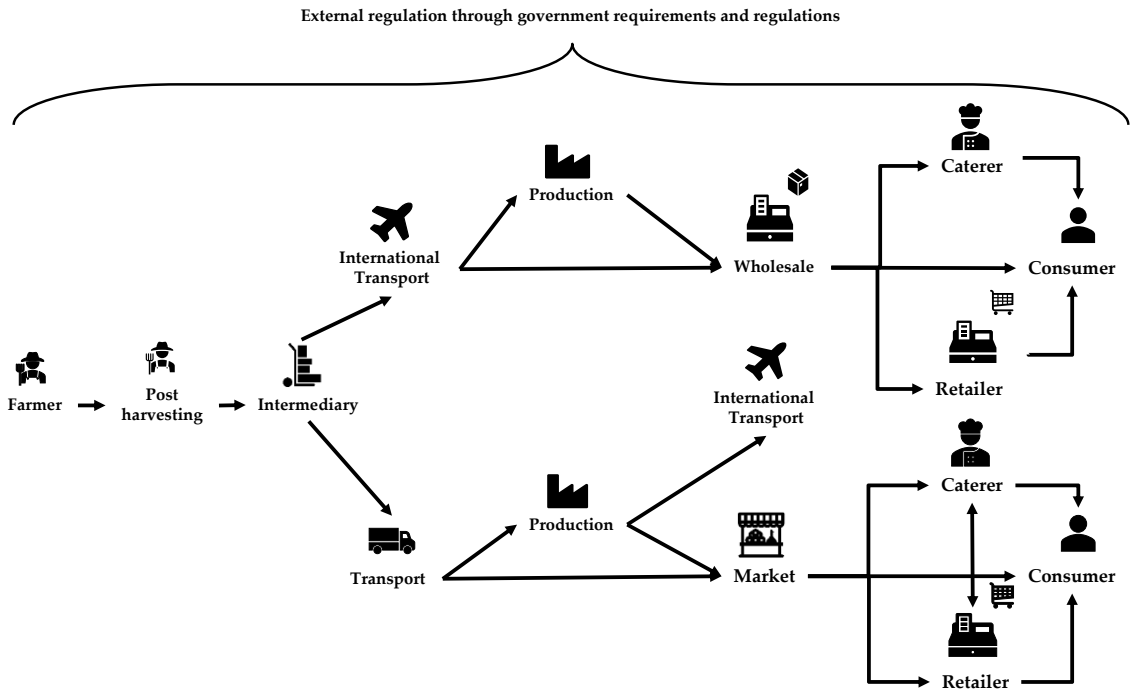

Figure 5 - Stages of a general food value network, own illustration with reference to Gustavsson et al. (2011) and Parfitt et al. (2010)

The food industry is highly competitive. Consumers expect food to be offered in retail stores in good quality, at reasonable prices and with a reasonable shelf life (Smith and Sparks 2009). In addition, a high product variety and the year-round supply of seasonal goods, e.g. fruit and vegetables, are required (van der Vorst et al. 2011).

Differences between the management of food value networks and other value networks lie in the importance of factors such as food quality, food safety and food freshness, always tied to a limited time frame. Consequently, the underlying value network is more complex and more difficult to manage than in other industries, such as furniture or textiles (Zhong et al. 2017). Due to demand and transport variability, the complexity within food value networks is greater, especially for perishable products, as lead times for storage or buffering are limited. The organization and coordination of a global food value networks is also more complex than that of regional value network. This means that resources such as trucks, storage facilities, transport routes and workers within the food value networks have to be used efficiently in order to ensure food quality and food safety through effective optimization decisions (Wu et al. 2016). The planning, design, and optimization

of all processes along the food value networks are therefore of primary importance for food logistics.

The structures of food value networks in East African countries roughly follow the structure of food value networks outlined above. However, they are characterized above all by the fact that food production is not dominated by large farms, as is the case in most industrialized countries, but that the majority of producers are small farmers. These are often grouped together in cooperatives and use these to put themselves in a better negotiating position with buyers. Furthermore, the networks in the following stage are characterized by a large number of intermediaries and transporters. This fact leads to a very small-scale network in the early stages, which brings with it a high degree of complexity in terms of transparency regarding the actor relationships.

Many of the food products produced in East African countries either remain in the country in an unprocessed state or are exported in an unprocessed state. Taking one of Ethiopia's largest export products, coffee, as an example, it can be seen that only green coffee is recorded as an export product in the Trademap database (International Trade Centrer 2022). Most locally consumed fruits and vegetables are also transported to the market, and thus to the final consumers, without further processing through several intermediaries and stations. In addition to producing its own food, the region also imports much of the food consumed locally. Most of the East African countries examined here have a trade deficit in terms of food imports and exports. For Ethiopia, the comparison of food exports and imports shows a negative balance of -1.877.97 million US dollars. (International Trade Centrer 2022). Ethiopia imports mainly cereal products and animal and vegetable fats. Exports focus primarily on coffee. **Figure 6** shows a comparison of Ethiopia's 5 most imported and 5 most exported products.

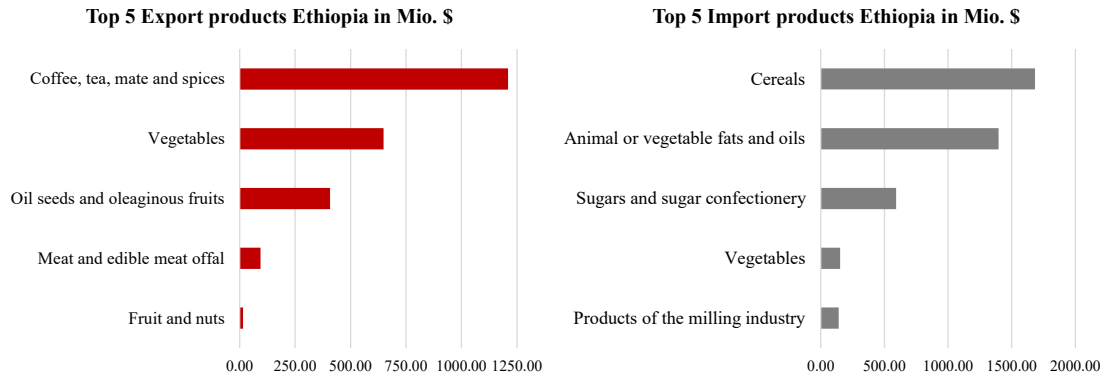

Figure 6 - Comparison of Ethiopia's food imports and food exports

The picture is similar for Rwanda and Kenya. At -152.53 million U.S. dollars and -123.33 million U.S. dollars, these countries have a somewhat negative trade balance between food imports and exports (International Trade Centrer 2022). Both also import cereals and fats to a large extent and have coffee as their main export product. **Figure 7** shows a comparison of the 5 most imported and exported products of the two countries.

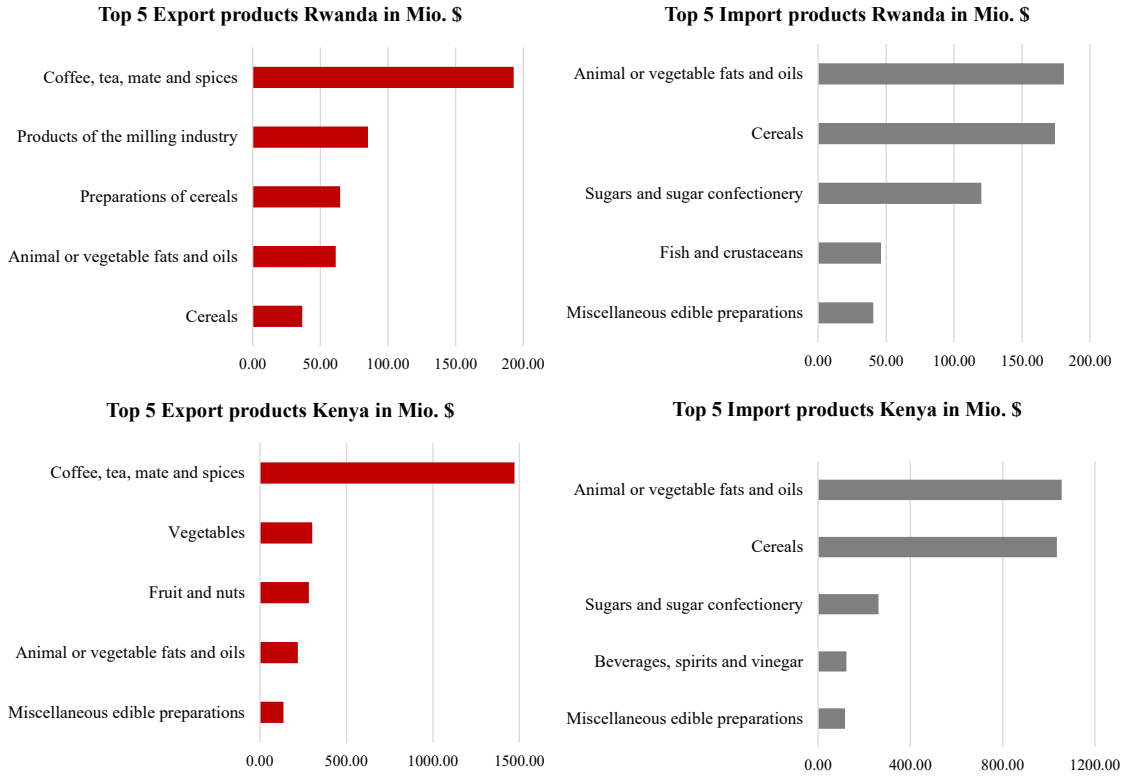

Figure 7 - Comparison of Rwandan and Kenyan food imports and food exports

Tanzania is the only country with a positive trade balance. Here, the difference between exports and imports amounts to 908.37 million US dollars (International Trade Centrer 2022). Tanzania exports a lot of cereals and vegetables. However, the imported products are also similar to those of the other countries. **Figure 8** shows a comparison of the 5 most imported and exported products of Tanzania.

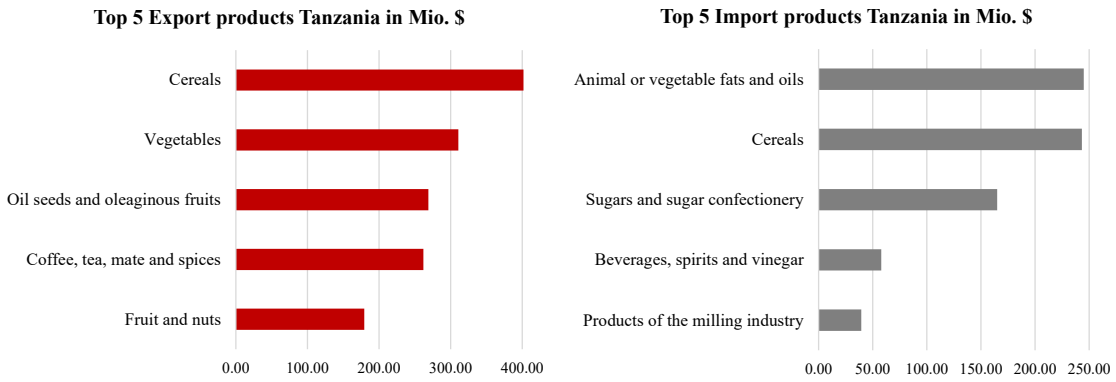

Figure 8 - Comparison of Tanzania's food imports and food exports

Governments are involved in many decisions regarding food value networks and have direct influence on their development. For example, as part of its development plans, the Ethiopian government emphasizes its willingness to promote the food industry, among other things, by entering into and improving collaborations and partnerships with international and local institutions (THE UNITED REPUBLIC OF TANZANIA 2021; Melkamu T Wazza 2022). Moreover, in Ethiopia, for example, non-governmental organizations (e.g., farmers' associations) are increasingly being integrated into the development of new policy regulations and legislation to improve the business environment for smallholder farmers. Nevertheless, the Ethiopian government continues to enforce strict and unpredictable regulations that severely affect the functioning of some institutions. In some cases, policy regulations can act as strong barriers that severely hinder, for example, the achievement of necessary business production volumes or the establishment of farmer associations. In some cases, political regulations can act as strong barriers, for example, strongly hindering companies from achieving necessary production volumes or establishing farmers' associations. Furthermore, it should be noted that the Ethiopian government's basic willingness to change conditions in the food sector does not necessarily result in the development and implementation of effective measures. In recent years, the government in Rwanda has promoted the formation of cooperatives in order to

give small farmers both better access to necessary input factors (seeds, fertilizer, etc.) and better negotiating positions towards buyers.

It can be seen that the export market in the countries under consideration is strongly focused on plant-based products. This is consistent with consumption habits in the region itself. The staple foods are mainly rice, corn, millet and manioc, which is also called cassava (Ihle et al. 2011). Also grown in the region on a large scale are fruits and vegetables like mangos, avocados, tomatoes and also coffee cherries for the production of coffee beans (Sarris and Morrison 2010). As a result, plant-based foods occupy a very important position for both the local and export markets in the analysed East African countries. For this reason, this dissertation focuses on plant products. This means that explicitly animal products are not considered in the analyses of this dissertation. No further differentiation or focus on a single food product is made. The amount of case studies and survey participants available for this dissertation would not be sufficient for a scientific analysis if limited.

2.4 Food losses

Food losses are defined by the FAO as any change in the availability, edibility, tolerance or quality of the food that prevents human consumption (FAO 2013, 2017b). In this context, food losses can be divided into three sub-categories:

- Avoidable food losses include food that was still edible and wholesome at the time of disposal or would have been if used in time.
- Partially (optionally) avoidable food losses are foods that are still edible in the true sense of the word but are disposed of due to consumer habits. These include bread crusts, apple peelings, but also leftovers and canteen scraps.
- Unavoidable food losses include food components that are removed as a result of further processing, such as in the preparation of food. These are mainly components such as seeds, bones, banana peel or bones, but also edible components such as potato or apple peel (Koester 2012; Kranert et al. 2012).

Avoidable food losses must be clearly separated from unavoidable ones in order to uncover potentials that can be exploited through efficient logistics solutions (Straube et al. 2016). This dissertation focuses exclusively on the category of avoidable food losses.

Furthermore, a distinction is made between food losses within the food value networks and so-called (consumer) food waste (Gustavsson et al. 2011). The latter describes food waste at the household level.

In 2015, a study by Deloitte presented figures showing how the total food that cannot be used for human consumption is distributed between losses and waste. This overview can be found in **Figure 9** (Deloitte 2015).

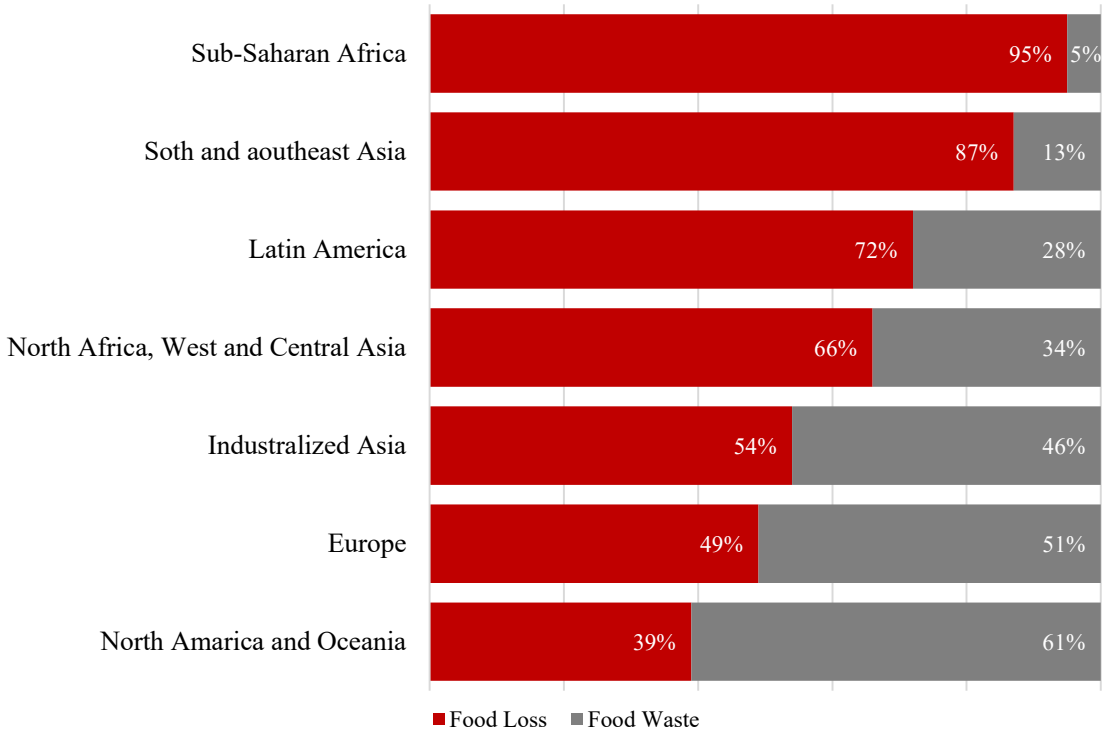

Figure 9 - Food losses vs food waste by region (Deloitte 2015)

Accordingly, especially in Sub-Saharan Africa, which is the focus region of this work, the share of losses in the value networks accounts for over 95% of all food losses and wastes. Thus, here the actors in the value network have a considerable share in the development of solutions to reduce losses. End consumers have only a small share of the responsibility in Sub-Saharan Africa. In industrialized countries such as Europe and America, on the other hand, end consumers have a much greater responsibility, accounting for more than 50%. Even though the topic of food waste is of great importance for the global efforts to reduce food discarding, it will not be considered in detail in this work, as the food value networks actors (companies and organisations) especially in the regions East Africa in the focus of this work do not have a relevant influence on the behaviour of customers after the purchase of the goods.

2.5 Current status of global efforts to reduce food losses

In the Sustainable Development Goals, the global community has set itself the goal of halving food losses and waste by 2030. Based on this goal, there is a multitude of activities of different actors. Even if the specific target of halving suggests that there is a clear knowledge of the current loss figures, it must be noted that this is not the case. Globally, it is mainly FAO estimates from 2011 that are referenced when talking about quantifying losses and waste. While setting the SDGs, however, there have also been efforts to build up a more accurate database of global losses and wastes. To this end, for example, the FAO launched the so-called “Food Loss and Waste Database". This is a database in which the FAO tries to summarize all available figures on global losses. However, numerous experts conclude that an actual compilation of the real causes of losses can currently only be achieved with a great effort on the part of all the players involved. There are various obstacles here. On the one hand, there is no uniformity worldwide in the unit in which losses are measured. Some companies record their losses in weight (kilograms or tons), volume (cubic meters) or only the monetary value generated by the losses through disposal or similar. Thus, a summary at this level alone is not trivial. In addition, there are many companies that have no or only insufficient records of the losses occurring in their processes. Here, especially in developing countries, there is the observation that companies have no awareness of the relevance of loss reduction and thus have no drive to deal with the topic in general and to create clarity about the extent of losses in their own processes. And further, the topic of losses is also a very sensitive one, also in the relationship between companies. Transparency about losses could weaken a company's negotiating position with its counterparties. Thus, it is understandable that some companies are reluctant to communicate their loss figures to the outside world, or even to talk about whether or not they record their losses.

The Food Loss and Waste Database is therefore not a database based on a single set of real loss figures, but the largest compilation of available figures on food losses in the world. More than 700 publications and reports from various sources were used, including subnational reports, academic studies, FAOSTAT and reports from national and international organizations such as the World Bank, GIZ, FAO, IFPRI, and other sources (Food and Agriculture Organization of the United Nations 2022). This compilation alone creates a clearer picture. It must be said, however, that even these figures do not always

come from real surveys. The Food Loss and Waste Database lists the type of result for each entry. The database shows that only 31% were collected through actual practical data collection (FAO's annual Agriculture Production Questionnaires 22%, survey 6%, Controlled Experiment 1% and Expert Opinion 1%). The other data come from Modelled Estimates (56%), National Accounts (9%), Literature Review 3% and unspecified collection methods (1%) (Food and Agriculture Organization of the United Nations 2022). In addition, the levels of coverage are very different for different country groups, food groups and sometimes regions. In some cases, the figures are recorded for individual actors. For many entries, however, there are only data which are recorded under the category "entire supply chain". Here a clear definition is missing, how the system boundaries are set and if they are the same for all entries. Also, with this data there is no possibility to make statements about transnational value networks. It is not clear from the information in the database whether imported goods are included from a certain point or whether the figures focus exclusively on networks whose source and sink are in the same country. It remains unclear whether and, if so, in what form losses on international transports are recorded.

Despite this limitation, the Food Loss and Waste Database currently provides the best way to get an overview of current loss figures worldwide. **Figure 10** shows the loss figures available in the Food Loss and Waste Database for the category "entire supply chain" for all European and African countries included in the database. Countries not included are shown in white.

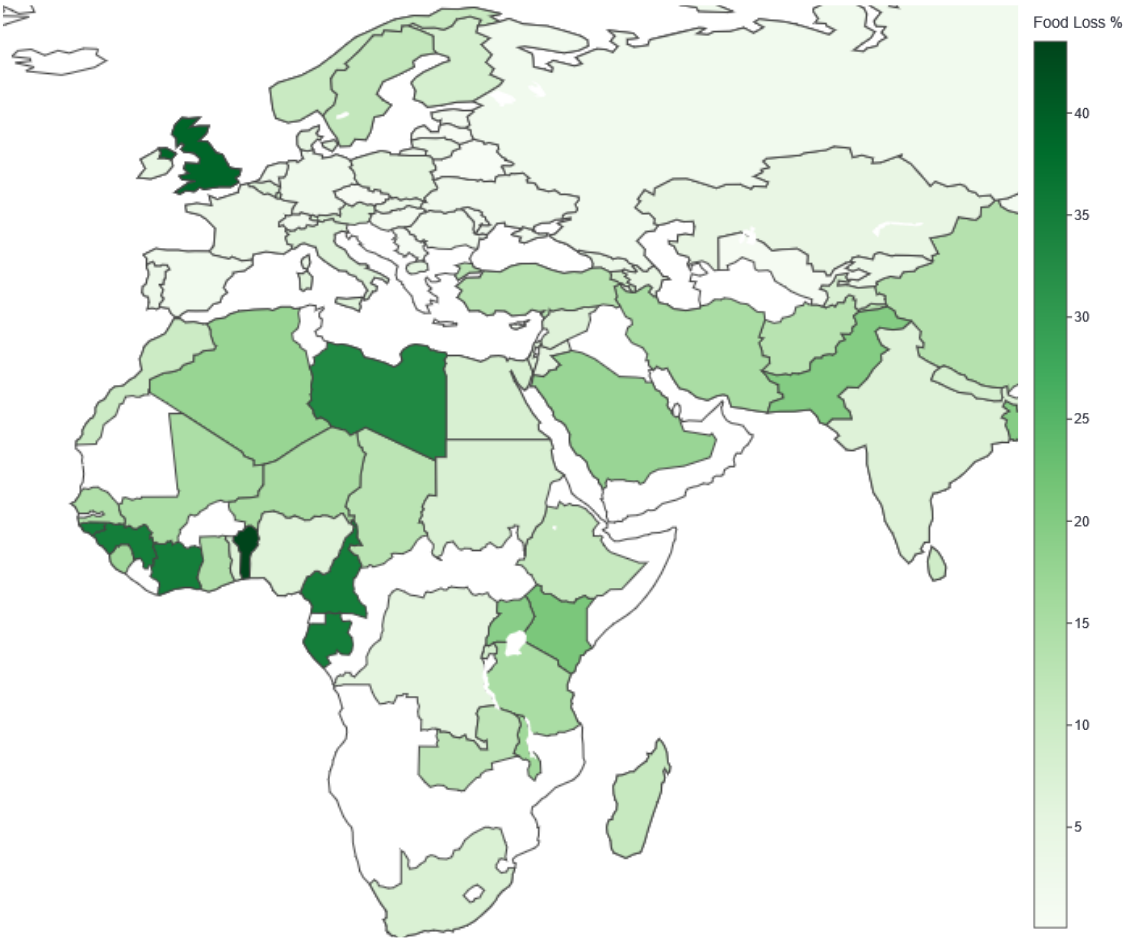

Figure 10 - Loss figures in percent in Africa and Europe according to the Food Loss and Waste Database

According to the figures recorded in the database, loss figures in Europe vary between 5% and 15%, with the UK a clear outlier at 40%. For the African countries covered, the average loss figures are 15 and 30% (Food and Agriculture Organization of the United Nations 2022).

2.6 Current status of food losses in East African food value networks

As already mentioned, the losses are generally not very validly quantified. This is also true for East Africa. However, there is some dispute about the causes of food losses in the region. For example, it can be noted that due to a lack of collateral such as credit ratings, land titles, or capital investments, it is particularly challenging for smallholder farmers to obtain funding and loans from financial institutions. For this reason, many farmers lack the necessary access to technical knowledge to improve their agricultural processes and also lack sufficient financial resources to purchase seeds, fertilizers and appropriate equipment. As a result, yields are reduced due to increased susceptibility of crops to diseases, such as fungi and other root diseases, and harsher weather conditions, including strong winds, long dry spells, etc. Furthermore, improper training of workers at harvest time is another major cause of food losses.

In terms of post-harvest handling and storage activities, the main causes of food losses among smallholder farmers are the storage technologies implemented. For example, up to 40% of the grain crop can be damaged by aflatoxins and other fungi if not previously treated with chemicals in wooden sheds; likewise, losses can be attributed to rodent or insect infestations. Furthermore, many producers lack refrigeration capacity for preserving fresh animal products (Bantayehu et al. 2017).

Similar to the previous stage of the value network, financial constraints are the main cause of high losses rate for farmers in their storage activities. Smallholder farmers interviewed indicated that lack of economic resources prevented many farmers from purchasing the necessary insecticides and fungicides or investing in expanding their storage facilities.

On the side of the buyers, who purchase directly from the farmers, and the intermediaries, whose main task is to deliver the goods to the next customer, the biggest cause of food losses is the inadequate transportation of the products. The long transportation times and heavy stresses associated with poor infrastructure led to higher costs and lower delivery quality. Fresh food is particularly susceptible to such losses during the transportation process due to its nature and perishability. Against this backdrop, inadequate and inefficient coordination, and cooperation between the various actors in the value network plays a particularly important role, which is the cause of a large proportion of food losses and results in an economic loss for the actors involved. In addition, the lack of adequate

facilities for the different types of food during transportation also frequently leads to food losses. Consequently, transportation and logistics act as important key elements in addressing the causes of food losses.

The main causes of losses at the distribution level are largely due to defects in the mechanical processing of raw materials. Thus, according to the study, this cause acts as the main driver of food losses in Ethiopia for over 55% of respondents. In terms of coffee production, the main source of losses is sun drying of beans, as this process requires particularly dry and sunny weather and is accordingly subject to a variety of uncertainties. In addition, human error and packaging problems were also mentioned as major causes in the interviews conducted. Furthermore, the use of inadequate and/or outdated traditional processing methods, as well as the lack of expertise of the employees, favours further food losses. Finally, the exclusion of food deemed unsuitable for further processing is also a factor at this level that results in food losses.

Produce is sometimes stored for too long under inappropriate conditions to await price fluctuations, resulting in severe quality losses at the distribution level. On the other hand, products are often sold at favourable prices directly after harvesting in order to avoid storage losses. Furthermore, there are losses at the distribution level due to long transport times and poor transport conditions, caused by a lack of means of transport. Food often cannot be sold due to aesthetic quality standards. Lack of refrigeration facilities at local and regional markets leads to further losses at the distribution level. Damage to products at markets.

3 Article 1

Title:

"Fields of Action for Designing Measures to Avoid Food Losses in Logistics Networks"

Published in

Sustainability 2020, 12, 6093; doi:10.3390/su12156093

3.0 Positioning of this article in the context of this dissertation and the logistic management model

In order to achieve the goal of this dissertation, namely the development of a logistic management model that supports organizations to reduce food losses in East African food value networks through the application of logistical measures, it is necessary to identify the appropriate measures. In the preliminary analyses for this dissertation, it was found that the concrete measures that organizations can implement are highly individual, as they depend on many individual factors. Therefore, it is hardly feasible to think about and explain all possible options for measures in a general way. Instead, for this dissertation a general approach was chosen to derive fields of action in logistics that enable the reduction of food losses in value networks. This objective was pursued in the following article. This article had the goal to identify fields of action, which can be used in the context of logistics for the reduction of food losses in food value added networks. It should be noted that this part of the analysis was not limited exclusively to the region of East Africa. Thus, areas of action have emerged here that apply generally to food loss reduction in the context of logistics in food value networks. The reference to East Africa is established by a survey in the context of the fifth chapter of this dissertation. These fields of action are incorporated in the logistic management model in the third phase, where they are assigned to the organizational profiles and used as recommendations for action for the applying organizations.

At the time that work was done on this dissertation for this article, the terms food logistics network, food value chain and food value network were used synonymously. For this reason, this article refers to logistics networks. In the context of this dissertation, this means the same as the food value network, which was defined in chapter two.

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3.1 Introduction

Overcoming the challenges in current food supply systems is crucial in providing enough food for a continuously growing world population. While resources for food production are limited, the Food and Agriculture Organization of the United Nations (FAO) estimates that approximately one-third of the food produced does not reach the consumer (FAO 2017a). Lost food is not only a problem because it cannot be used to feed the people who need it, but also because it involves a considerable waste of resources (FAO 2017b). Eliminating current food losses would be enough to meet the caloric requirements of 1.9 billion people at a time when, according to the United Nations (UN), about 815 million people worldwide are suffering from hunger (UNITED NATIONS 2017). Considering FAO statistics, it is evident that significant losses are occurring both on the consumer end and within the value chain (Gustavsson et al. 2011). Therefore, it is generally accepted that issues in the global food supply do not reflect a production problem but a distribution issue (Hiç et al. 2016).

The food loss problem is not a new phenomenon. Though it has not been in the public spotlight for long, this topic has gained new momentum through various initiatives, resulting in its integration into the UN's 17 global sustainable development goals. The 12th sustainable development goal "responsible consumption" includes a sub-objective (12.3), stating that, by 2030, global food losses should be reduced by half throughout the entire food value chain, including post-harvest losses and the end consumer (UNITED NATIONS 2015b). This objective directly addresses the core functions of logistics and supply chain management, thus representing a direct task for this area of industry and science.

In the current scientific literature, there are many reports on preventive strategies for food loss (Nitsche et al. 2018). Some research deals with the appropriate use of technologies while other studies describe design processes that can reduce losses. However, the approaches described in the literature usually address a specific case study or relate to the properties of a particular food group. Despite promising results in their respective fields, these approaches can only be transferred to a limited number of other situations.

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A more generally applicable solution could be formulated by considering the fields of action underlying the design of the measures described in the current literature. This study provides an overview of such fields of action, as reflected in the following research question:

RQ1: Which criteria are set as objective parameters when developing logistics measures against food losses?

In order to answer this research question, we first turn to defining key terms in the research before describing the methodology. We then describe the results of the analysis and discuss them in detail afterward.

3.1.1 Food logistics

This paper begins by providing an overview of the terms “logistics” and “supply chain management.” According to Straube (2004), the basic function of logistics is "[...] the economical and on-time production, provision and delivery of goods, materials, products and services ordered by customers. Logistics organizes processes, system structures and entire networks from increasingly globally distributed origins to globally distributed destinations " (Straube 2004) (p. 27). Though this definition covers logistics in a general manner, this paper refers to food logistics in particular, requiring greater specification. Based on this understanding of logistics, Straube, Nitsche, and Figiel (2016) further describe food logistics as follows: "Food logistics comprises the planning, management and control of the value-added network of food from the source of raw materials to the customer. The focus here is on the efficient processing of customer orders with the aid of information systems, technologies and management concepts, with special consideration of high article-specific quality and safety requirements for perishable goods in various temperature ranges" (Straube et al. 2016) (p. 6). This understanding of logistics is applied in this paper.

In accordance with this view, food logistics are applied along the entire food value chain. Various approaches in the current literature describe the design of a generic food value chain. The most common representations differ mainly in terms of the level of detail for

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each of the defined individual steps within the value chain. To illustrate, we can compare the concepts of Parfitt et al. (2010) and Gustavsson et al. (2011) as examples. Gustavsson et al. (2011) present a definition of the food value chain in five stages. Starting with agriculture, processes like threshing, fishing, or milk production form the first stage. The second stage of the chain involves post-harvest processing, which includes sorting, drying, and cleaning processes. Additionally, it includes handling and storage, transport to slaughter for meat products, icing and packaging for fish products, and transport between farm and distribution for dairy products. In the third step, the raw materials are then processed into higher-quality food products, including actions such as product cutting and slaughtering, cooking, and shaping. This stage involves all procedures in the area of quality management, the physical distribution of products, the processes at wholesalers and in supermarkets, and the sales process. In this definition, the last stage of the food value chain refers to consumption (Gustavsson et al. 2011). By comparison, Parfitt et al. (2010) choose a definition with a higher degree of detail, consisting of eleven steps. Similar to Gustavsson et al. (2011), this definition starts with agriculture, but here, it explicitly includes harvesting and the handling of raw materials during harvesting in the first step. As a second step, this approach describes threshing, which is equivalent to the second step of the previously described approach, post-harvest processing. This step is separated from the actual processing stage, as they are usually carried out either directly in the agricultural enterprises or in enterprises nearby. As a third step, this approach describes the drying in connection with the transport and distribution of raw materials, while the fourth step involves storage. This storage phase is followed by primary production in the fifth step, secondary production in the sixth, and quality control in the seventh. The eighth step involves packaging, including weighing, labelling, and sealing, while the ninth step focuses on marketing—generating publicity, selling, and distributing to the end customer. The consumer stage occurs in step ten before giving way to the eleventh step, the end of life, which is understood as the removal of waste at various stages of the value chain (Parfitt et al. 2010). **Figure 11** illustrates these two descriptions of the generic food value chain.

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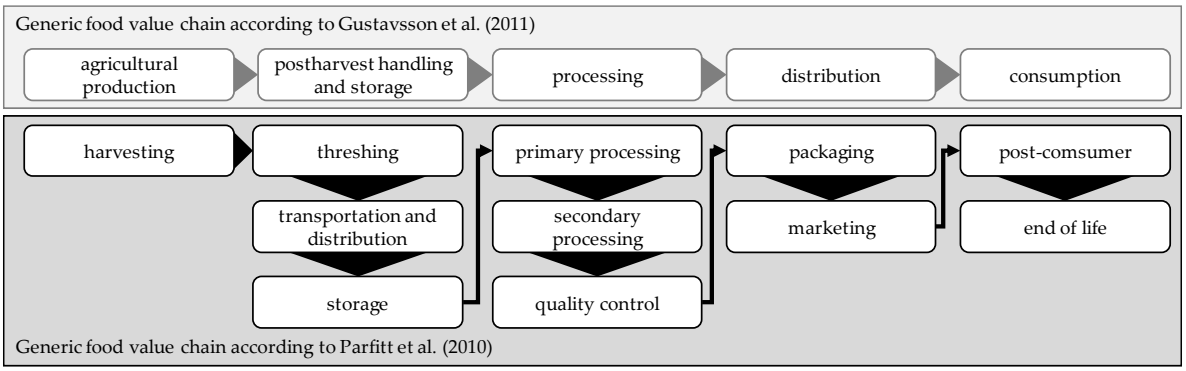

Figure 11 - Generic food value chain (Parfitt et al. 2010; Gustavsson et al. 2011).

Both approaches outline the most important process steps of a generic food value chain, which relate to the actors directly involved. However, it should be noted that not all relevant actors are covered by the process steps. In comparison with other sectors, the food value chain is characterized by a high degree of influence from indirect actors. For example, Dani (2015) emphasizes the important position of regulatory authorities. Governmental regulation plays a particularly important role, as it sets out individual regulatory requirements for each country, for aspects like product quality. Governmental regulation is also important in international food value chains because different countries have varying requirements and guidelines with regard to market liberalization and protectionism against foreign imports (Dani 2015). **Figure 12** provides a schematic illustration of the actors and functional areas in international value chains.

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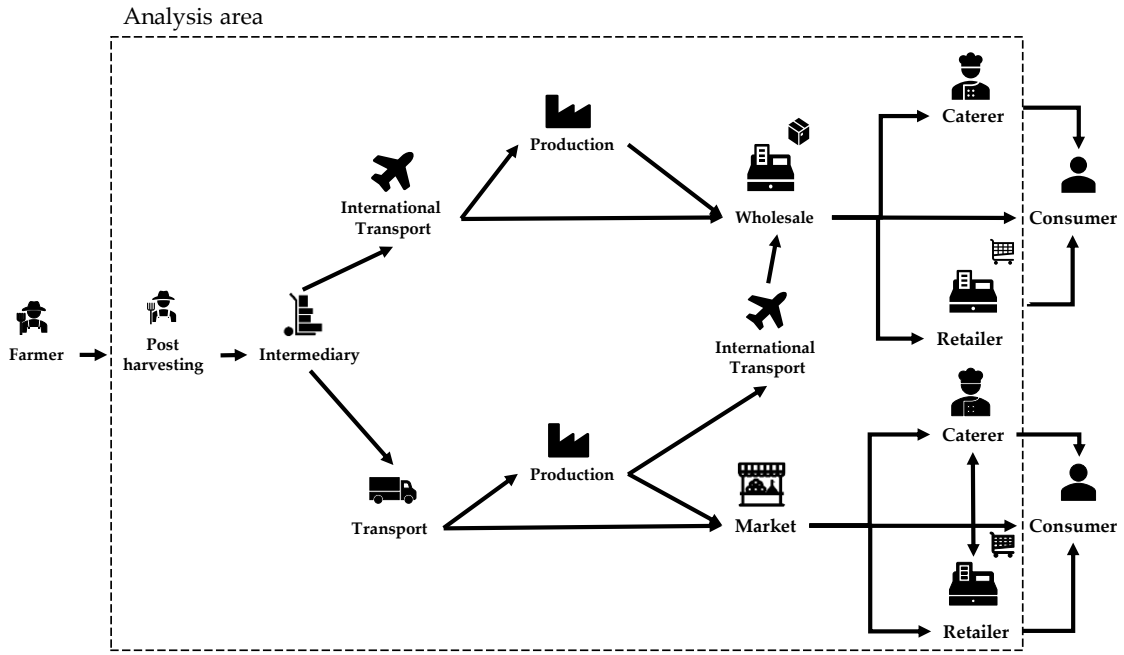

Figure 12 - Functional areas and actors in international food value chains

The current study investigates measures that can be implemented by direct and indirect actors within the food value chain using the logistics framework and definition described in this section. Following this understanding of logistics, the current study will consider the food value chain only in the context of an environment that is directly influenced by these actors. According to this understanding, the consumer level is not considered, as it lies outside the described actors' sphere of influence.

3.1.2 Food loss reduction management

The literature also includes various descriptions of the terms "food loss" and "food waste". According to the definition by the FAO Report "The State of Food and Agriculture" (2019), food loss is "the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retail, food service providers and consumers." (English 2019) (p. 5). Distinct from food loss, food waste is understood as " the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food services and consumers." (English 2019) (p. 5). Some authors make no distinction between these terms and combine them into "food loss and waste" (Parfitt et al. 2010; Kowalska 2017). The High-Level Panel of Experts on Food Security and Nutrition of the European Union (HLPE) defines the terms as follows: "Food

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losses (FL) refers to a decrease, at all stages of the food chain prior to the consumer level, in mass, of food that was originally intended for human consumption, regardless of the cause." Meanwhile, "food waste (FW) refers to food appropriate for human consumption being discarded or left to spoil at consumer level – regardless of the cause." (HLPE 2014). As the latter definition of food loss has the largest intersection with the scope of this study, the term "food loss" is used in accordance with the understanding of HLPE 2014.

The causes of food losses are complex and depend on conditions in the respective processes as well as the level of development in a given country. Parfitt et al. (2010) and Nitsche et al. (2018) describe the different causes of loss in developing and industrialized countries, an overview of which can be found in **Table 1**.

Table 1 - Causes of losses in food value chains

Value chain stage	Developing countries	Developed countries
Harvesting and post-harvesting	❖ weather-related loss ❖ suboptimal harvest period ❖ damage of crops ❖ inadequate infrastructure ❖ low level of automation ❖ defective harvesting equipment ❖ lack of qualified personnel	❖ weather-related loss ❖ over-production ❖ damage of crops
Food processing industry	❖ transformational processes ❖ contamination	❖ transformational processes ❖ production failures ❖ technical issues
Warehousing	❖ low storage capacity ❖ inappropriate storage conditions and cooling systems ❖ long distances to warehouses ❖ warehouse usage not aligned to customer demand	❖ technical malfunction of cooling systems ❖ manual errors in cooling regulation ❖ inappropriate storage conditions
Transportation	❖ inadequate infrastructure ❖ inappropriately equipped transport vehicles ❖ low transportation safety for perishable goods ❖ unreliable transport packaging ❖ inappropriate load securing	❖ long throughput times ❖ long transport distances ❖ delivery delays ❖ overloading of terminals ❖ inadequate temperature measurements ❖ unreliable transport packaging
Retail	❖ lack of cooling systems	❖ inaccurate sales forecasts

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	❖ inappropriately equipped storage and sales areas ❖ unhygienic conditions	❖ uncertainty regarding date indications ❖ inappropriately equipped sales areas ❖ inefficient optimization efforts ❖ promotions and discounts
Packaging	❖ lack of packaging knowledge ❖ inappropriate packaging for transportation and storage	❖ large packaging units ❖ defective packaging ❖ inefficient packaging design
Processes	❖ lack of holistic view of value adding ❖ processes in food value chains due to profit optimization ❖ lack of communication between food value chain actors ❖ inefficient processing processes	❖ high complexity of value-adding processes ❖ lack of holistic view of value-adding processes in food value chains ❖ lack of communication ❖ lack of transparency along the food value chain
Guidelines and regulations		❖ specification of aesthetic standards of regulating authorities ❖ high consumer requirements ❖ guidelines for waste disposal due to non-suitability for processing ❖ seasonality or weather-related change of quality/appearance specifications by retailers ❖ rules to ensure that there is a minimum time left to the expiration date

3.1.3 Measures to combat food losses

In categorizing the many different approaches to dealing with food losses in the food value chain, Papargyropoulou et al. (2014) created the so-called food waste hierarchy, which is shown in **Figure 13.**

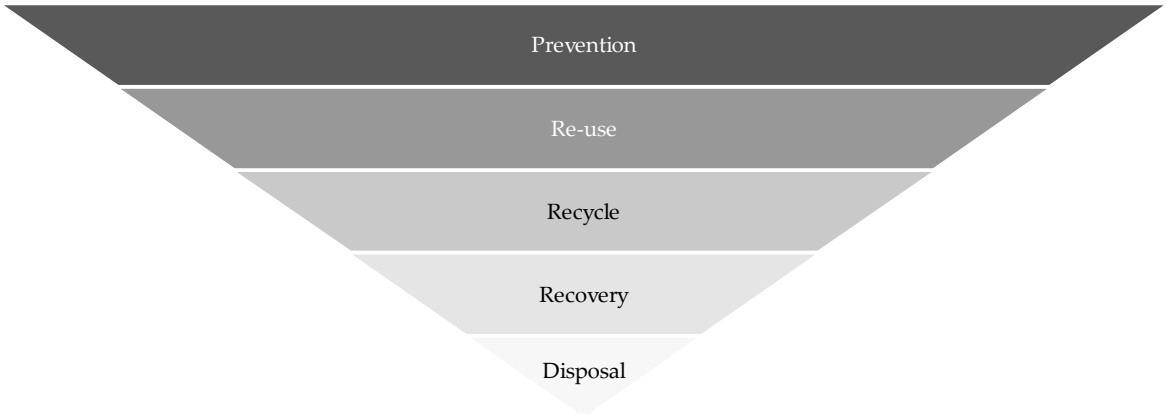

Figure 13 - Food waste hierarchy (Papargyropoulou et al. 2014).

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In the first stage, prevention involves avoiding food surpluses or losses during production and consumption within the food value chain. Re-use refers to measures to pass on food surpluses to those in need, such as through redistribution networks. Recycling includes the subsequent use of surpluses for animal feed or composting. Recovery refers to the production of energy through these surpluses. The last level of the hierarchy is disposal, which describes the elimination of surpluses in a technical landfill. According to Papargyropoulou et al. (2014), the stages should be followed in the order described here, if measures are to be taken against food losses (Papargyropoulou et al. 2014). According to this definition, prevention is the most desirable form of action; as such, the following section of this study will consider measures that pursue this objective.

A great deal of research has focused on addressing loss prevention. For example, Nitsche et al. (2018) provide an overview of various measures, referring to a connection between the stages of the value chain and the measures implemented. This overview is shown in **Figure 14**.

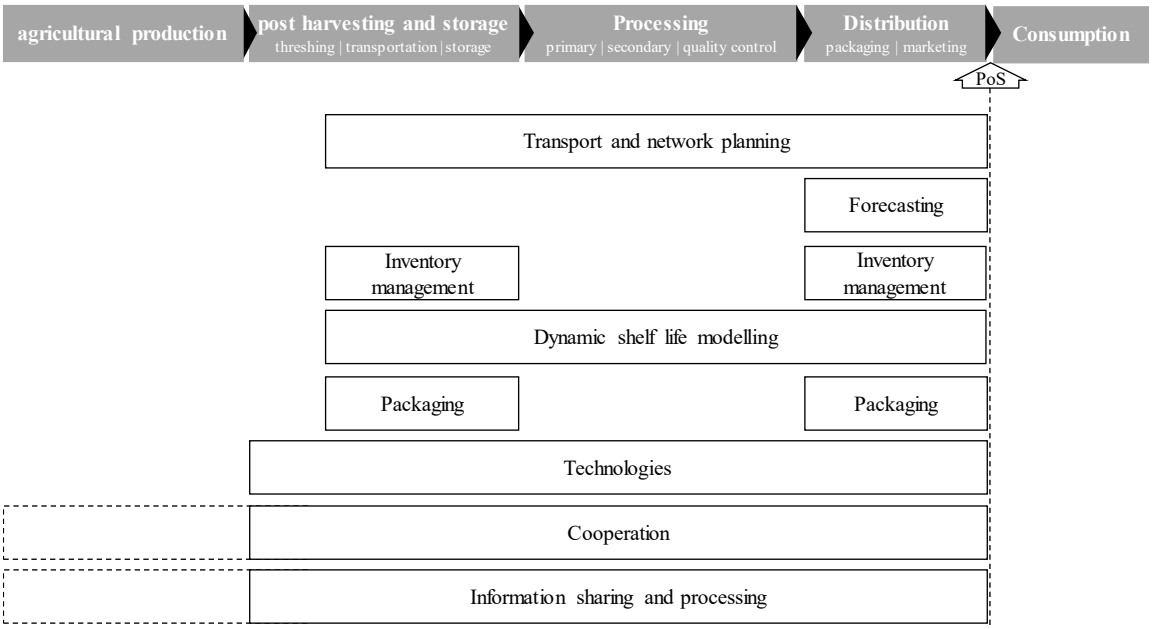

Figure 14 - Assignment of measurement clusters to the stages of a food value chain (Nitsche et al. 2018).

This overview shows that there are measures in many different areas of the value chain. However, this view refers exclusively to the measures implemented and does not provide

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any decision support for users seeking to develop a suitable measure for a specific application. What is missing for this purpose is a set of fields of action oriented towards specific objectives. Such a set of fields would make it possible to develop practical and customized solutions for individual cases.

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3.2 Materials and methods

The research methodology follows Nitsche and Durach's (2018) research, pursuing a dual approach that incorporates both the perspective of science and the perspective of logistics practice (Nitsche and Durach 2018). Firstly, this study incorporates open interviews in order to integrate the practical side. Secondly, a systematic literature analysis assists in mapping the research question. By triangulating the data from both sources, comprehensive statements can be made.

Six open interviews were conducted with practitioners from companies and organizations operating within the range of the above-mentioned value chain structure. The interviews opened with the following question: which measures against food losses have you already implemented or noticed in the environment? Subsequently, the interviewers inquired more deeply into the objectives behind the described measures before discussing the areas in which improvements could be achieved. Based on these interviews, different criteria were extracted and used to design measures against food losses according to the experts' statements. From the six interviews, a total of 24 criteria were gathered.

The second part of the data collection is based on a systematic literature analysis by Durach (2016), who describes systematic literature analysis as a process with six phases (Durach 2015). Starting from a clear objective formulated in a research question, the need for research should be ensured by involving relevant stakeholders. Moreover, the researcher should reflect on the question of whether or not the question can be answered by reviewing the literature. The second step involves preparing the literature analysis by setting inclusion and exclusion criteria. In the third step, the literature search is carried out after choosing a methodology (e.g., database analysis, snowball sampling). Then, the analysis is performed by creating a search string and entering it into the selected databases. The fourth step involves applying the previously defined inclusion and exclusion criteria and assessing the quality or validity of the literature. The fifth step is the analysis and synthesis of the literature under investigation. Here, Durach (2016) does not specify an evaluation method. However, he describes the importance of an objective and transparent approach and recommends involving several researchers in this step-in

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order to minimize bias. The sixth step includes the dissemination of the results and the use of the research findings (Durach 2015).

The systematic literature analysis only included scientific journals. Renowned researchers in the field assisted in creating the search string. For this purpose, authors who were identified by previous basic analysis of the literature were contacted who had been active authors who had published on similar topics and whose contact details were openly accessible online. They were informed about the primary research question and asked to name terms that they would use for such a search. Out of 30 scientists contacted, eight responded. The search terms mentioned were compared with the previously identified terms, which were supplemented if necessary. This process served to minimize the influence of one person (researcher bias) and to develop a more comprehensive search string. To make the search string non-repeating, some words have been marked with asterisks to include different word endings in the search.

The search logic resulting from this process is shown in **Figure 15**.

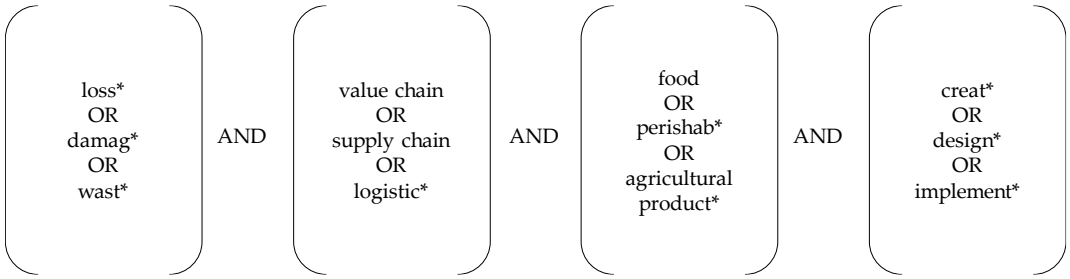

Figure 15 - Logic of the search string

The following inclusion and exclusion criteria were then defined:

Inclusion criteria:

- Only peer reviewed journals are used.
- Only journal articles written in English are used.
- Only articles that were available in the EBSCO Host and Web of Science databases at the time of the search (March–May 2019) are used. There was no limitation in terms of the year of publication.

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- Only articles showing a focus on the design of food logistics network in the title or abstract are used.

Exclusion criteria:

- Articles focusing on biological, chemical, or medical criteria will not be considered.
- Articles focusing on waste reduction at the level of the final consumer will not be considered.

The same terms were used for the search in the mentioned databases. Due to differing search logics, search strings were structured in varying ways. The search resulted in a total of 887 results in both databases. After correcting for duplicates (89) and deleting articles that did not meet the inclusion criteria (20 book contributions, one conference volume, and 18 anthologies), 759 articles remained for closer examination (reading the title and abstract). During this process, 649 articles failed to meet the inclusion criteria. **Figure 16** provides an overview of the distribution of the analysed articles' publication years.

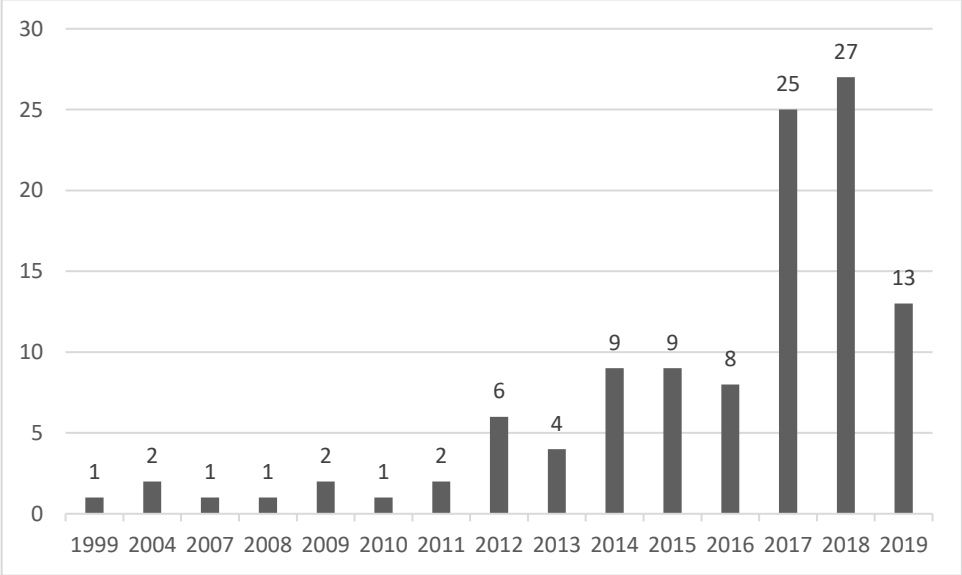

Figure 16 - Distribution of publication years of included articles

Among the 111 articles examined, 18 explicitly focused on value chains in developing countries. Seventeen articles explicitly addressed value chains in industrialized countries,

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while the remaining 76 articles made no statement about an area of focus, or they referred to both developing and industrialized countries.

The remaining 111 articles were read, and the criteria mentioned in the articles collected. In each case, the criteria described in the article or interview were noted. A total of 646 criteria were identified using the two data collection methods. The collection of criteria is illustrated in **Figure 17**.

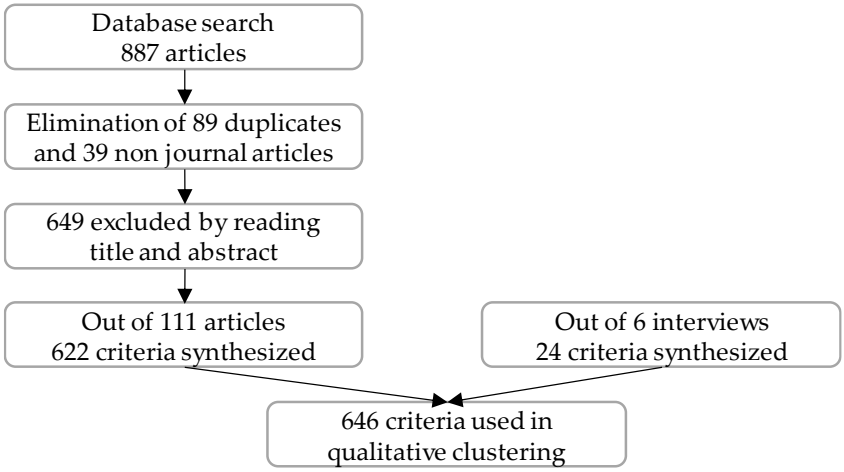

Figure 17 - Selection process

Using qualitative clustering, three researchers systematized the criteria identified in the study. The located criteria were presented to the three participants. In each case, they discussed whether the criterion fit a previously found criterion or whether it encompassed a new group. This approach gradually led to the creation of fields of action, which were then structured more specifically and combined to form a complete overview.

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3.3 Results

The identified fields of action can be classified into four main groups. The first group refers to fields of action that aim to "optimize processes". The second group combines fields of action that relate to the "framework conditions" of the logistics network and are primarily addressed by the public sector. The third group refers to the "physical characteristics" of the respective food products handled. In this respect, major differences can be seen regarding the products under consideration. The fourth group includes the fields of action focused on "people" within the logistics network. **Figure 18** shows the breakdown of the identified fields of action for the groups mentioned.

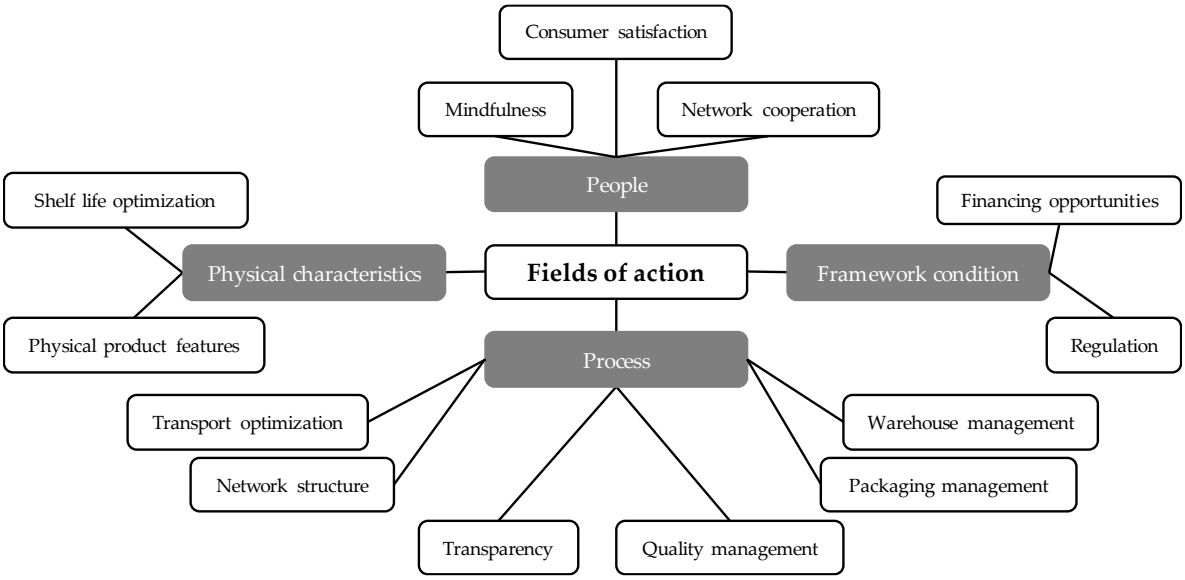

Figure 18 - Classification of fields of action

Table 2 shows the mapping of the articles found in the systematic literature analysis to the identified fields of action.

Table 2 - Mapping the literature to the criteria

Fields of action	Description	Literature
Transparency	Increase of transparency within a company as well as between companies of a network	Addisu Damtie 2015; Antman et al. 2014; Borit and Santos 2015; Brewster et al. 2017; Chaudhuri et al. 2018; Chimphango and Görgens 2015; Chuang et al. 2017; COLGAN et al. 2013; Faour-Klingbeil et al. 2016; Irani and Sharif 2016; Herbon and

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		Khmelnitsky 2017; Kaipia et al. 2013; Kamble et al. 2019; Manzouri et al. 2014; Martens et al. 2012; Melin and Barth 2018; Mercier et al. 2018; Muriana 2017; Notarnicola et al. 2017; Nabhani and Shokri 2009; Pinior et al. 2015; Powell et al. 2017; Sarpong 2014; Shah and Naghi Ganji 2017; Sharifzadeh et al. 2015; Strotmann et al. 2017; Vlachos 2015; Wang et al. 2012; Xiao et al. 2017
Quality management	Improvement of quality management for early detection of weaknesses	Azuara et al. 2012; Chelbi et al. 2008; Lau et al. 2018; Laux et al. 2015; Mor et al. 2018; Negi and Anand 2019; Tsang et al. 2018; Wilcock and Boys 2017
Packaging management	Improvement of packaging management during transport and storage processes as well as for distribution to the end customer	Akkas et al. 2018; Mack et al. 2014; Molina-Besch et al. 2019; Vanderroost et al. 2017; Verghese et al. 2015; Wikström et al. 2019; Wikström et al. 2014
Transport optimization	Improvement of transport management with regard to route planning, loading of vehicles, and coordination of vehicles	Ahumada and Villalobos 2011; Bortolini et al. 2016; CAIXETA-FILHO 1999; Hu et al. 2017; Memon et al. 2017; Mvumi et al. 2016; Validi et al. 2014
Warehouse management	Improvement of warehouse management using suitable storage equipment, storage strategies, and adapted layout planning	Facchini et al. 2018; Garbaba et al. 2018; Kiil et al. 2018a; Haijema and Minner 2016; Kiil et al. 2018b; Leśniewski and Bartoszewicz 2013
Network structure	Improvement of the network structure using strategic network planning and location management	Atkins et al. 2018; Gong et al. 2007; Orjuela Castro and Adarme Jaimes 2017
Regulation	Adapted regulations by the administration to support companies in reducing food losses as required	A. Rijpkema et al. 2014; Brunelle et al. 2017; Cristóbal et al. 2018; Mendedo et al. 2017; Pinstrup-Andersen 2014; Sharma et al. 2019; van Hoof and Lyon 2013
Financing opportunities	Providing appropriate financial support from the administration to weaker network partners	Brüntrup et al. 2018; Wu et al. 2017
Physical characteristics	Adaptation of processes to consider special physical requirements of the products, including temperature, pressure sensitivity, and air composition	Bakhtavar et al. 2019; Hafliðason et al. 2012; La Scalia et al. 2016; Martindale and Schiebel 2017; Raab et al. 2011; Raut and Gardas 2018; Singh et al. 2018

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Shelf-life optimization	Process adaptations that allow the shelf life of the products to be taken into account in decision making	Allen and Schuster 2004; Chen et al. 2018; Gogo et al. 2017; Kaya and Ghahroodi 2018; Tromp et al. 2012; Venuto and Mezzina 2018
Network cooperation	Improving cooperation within networks, including information sharing and efforts to develop comprehensive measures against food losses	Aggarwal and Srivastava 2016; Alarcon et al. 2017; Alberti and Belfanti 2019; Arias Bustos and Moors 2018; Borrello et al. 2017; Despoudi et al. 2018; Devin and Richards 2018; Fang Du et al. 2009; Fu et al. 2018; Henningsson et al. 2004; Kouwenhoven et al. 2012; Liljestrand 2017; Lozano and Adenso-Díaz 2018; Lutz et al. 2017; Markelova and Mwangi 2010; Mena et al. 2014; Ocicka and Raźniewska 2018; Song and He 2019; Tsuchiya et al. 2015; Warshawsky 2016; Yu et al. 2018; Zhou et al. 2019
Mindfulness	Promoting awareness among employees at all levels in companies of the relevance of the problem of food losses in everyday life	Alamar et al. 2018; Al-Madbouh et al. 2019; Bonadonna et al. 2019; Martindale 2017; Weidner et al. 2019
Consumer satisfaction	Adaptation of internal processes with the aim of meeting specific customer requirements	Aschemann-Witzel et al. 2017; Pan et al. 2017

3.3.1 Optimizing processes

Six fields of action were identified in the process optimization group, with transparency being the most frequently mentioned within this group. Indeed, 29 articles and three expert interviews addressed this issue. In this context, transparency is understood as the creation of a uniform information base within a company or across a logistics network. By reducing information asymmetry, decisions are better coordinated, and network partners have the opportunity to react better to their partners' actions. Nearly all of the articles mentioned the use of technology for realizing transparency. However, some researchers also explained more profound interrelationships and described the added value of transparency for the networks (Addisu Damtie 2015; Faour-Klingbeil et al. 2016). Sarpong (2014), for example, examined the influence of the horse meat scandal on the European market and its effects on discussions of transparency (Sarpong 2014). In terms of technology use, researchers discussed a variety of procedures, including the use of real-time monitoring for cross-company processes (Chuang et al. 2017). Other articles discussed the introduction of the Internet of Things and analysis methods based on it

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(Kamble et al. 2019; Brewster et al. 2017). According to this analysis, the introduction of tracking and tracing technologies is an important step towards a uniform information base across a network (Sarpong 2014; Chuang et al. 2017; Brewster et al. 2017; Borit and Santos 2015; Xiao et al. 2017). Also of high importance in the field of action for transparency is the use of decision-making tools that provide the decision maker with information permitting a more transparent decision-making process (Chaudhuri et al. 2018; Pinior et al. 2015). Another group of articles discussed the introduction of lean philosophy, which should lead to a more efficient process while encouraging a higher level of process understanding and create additional knowledge and transparency (Vlachos 2015; Powell et al. 2017; COLGAN et al. 2013).

The second most frequently mentioned field of action is the improvement of quality management. Eight of the articles identified in the current research deal with this topic. This field of action involves seeking to detect errors in the process as early as possible in order to mitigate them. Researchers that used measures in pursuit of this objective also tended to use technology, which was also mentioned in terms of transparency. For example, Azuara et al. (2012) discussed introducing effective tools that make it possible to detect faulty or counterfeit products in incoming goods, thus facilitating the handling of such products before they are introduced into the production processes (Vlachos 2015; Azuara et al. 2012). Studies have also mentioned process structuring and adapting current quality regulations (Negi and Anand 2019; Chelbi et al. 2008). Similar technologies to those already mentioned in creating transparency also contribute to increasing and improving quality management. Thus, several authors pointed to certain technologies that aim to improve quality management. For example, tracking and tracing leads to improved quality management (Laux et al. 2015; Lau et al. 2018; Wilcock and Boys 2017). Studies also highlight the monitoring of temperature in cold chains as an effective tool for quality control (Mor et al. 2018; Tsang et al. 2018).

Another field of action assigned for process optimization is packaging management. Here, packaging management is understood as the effort to pack goods appropriately for process steps during transport, handling, and storage. It also means designing packaging in such a way that it leads to the smallest possible amount of waste at the end-customer

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level. Seven articles and one interview addressed this topic. Within this area, many articles did not mention the reduction of food losses as the primary goal of the presented measures, a finding that is in contrast with most other articles examined in this analysis. Packaging management also was mentioned in the context of reducing packaging material usage, using sustainable packaging materials, and lowering process costs (Vanderroost et al. 2017). Many articles focused on designing the packaging in such a way that the final product creates as little waste as possible. In this sense, the topic of packaging size came up in several articles (Akkas et al. 2018; Wikström et al. 2019); meanwhile, the topics of separation within packaging and the labelling of packaging also appeared (Molina-Besch et al. 2019).

Another identified field of action is transport optimization, which involves the optimization of operative transport processes as well as route planning. Seven articles discuss this topic. Articles assigned to this field of action dealt mainly with the development of mathematical models for route optimization (Hu et al. 2017; CAIXETA-FILHO 1999; Bortolini et al. 2016). In addition, the authors discussed the need for reliable transport processes to ensure that food is not wasted by delayed transport or inadequate load securing (Mvumi et al. 2016).

Warehouse management was identified as a further field of action. In this context, warehouse management is understood as the use of effective methods for optimizing warehouse management and for adjusting warehouse layout to meet requirements. A total of six articles fit into this category. The identified articles primarily focused on implementing reasonable warehouse strategies, such as the "first expired first out" principle (Leśniewski and Bartoszewicz 2013). Other authors concentrated on warehousing and the specific requirements of the early stages of the logistics network, more specifically, on the level of farmers. These studies focused on farming structures in developing countries and the specifics of the adaptation necessary for effective warehousing in these areas (Garbaba et al. 2018). A few authors also discussed the optimal warehouse layout for shortening distances and keeping the duration of products' stay within warehouses as short as possible (Facchini et al. 2018).

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The optimization of the network structure also was identified as a field of action. Here, adaptation of the network structure refers to the objective of building an efficient distribution network. Increasing the efficiency of these measures reduces food loss. Three articles fell into this field of action. In this context, it should be noted that reducing food loss is only a sub-target. Thus, this field of action differs from most of the other fields of action, which were identified as clear main goals in terms of reducing food loss. These articles primarily focused on strategic planning approaches to optimizing network design and developing an optimized distribution network (Gong et al. 2007; Orjuela Castro and Adarme Jaimes 2017).

3.3.2 Framework conditions

Within the framework conditions group, regulation was the most frequently mentioned field of action. Under this field of action, seven articles and two interviews were categorized. Regulation in this context means the intervention of governmental authorities on the processes within food logistics networks. Through the identified articles, it became clear that regulatory measures must be implemented cautiously; otherwise, they will lead to additional losses within the logistics networks (Brunelle et al. 2017; Cristóbal et al. 2018). This field of action usually is not set by the companies themselves; rather, it involves an external field of action that companies can influence through participation in initiatives, for example (A. Rijpkema et al. 2014).

The second field of action mentioned under framework conditions is financing opportunities. Here, financing opportunities refer to network partners receiving financial support either from other companies within the logistics network, or in most cases, from governmental or non-governmental organizations. This field of action was addressed in two articles, both of which explicitly refer to developing countries. The articles both contain detailed discussion of the fact that losses can be reduced by using targeted financial support, especially for network partners at the beginning of the value chain. This point is supported by the fact that, especially in developing countries, farmers with poor equipment depend heavily on their partners within the value chain. Therefore, they have

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little financial flexibility or chance at process innovations; as such, they do not focus on loss reduction (Wu et al. 2017; Brüntrup et al. 2018).

3.3.3 Physical characteristics

Among the physical characteristics group, the most frequently mentioned field of action involved physical product features, with seven articles assigned to this field of action. In this context, considering physical product features means conducting process optimization with the aim of aligning the food's physical environment to its requirements. Here, temperature, air composition, humidity, and pressure sensitivity are all considered. Optimally adapting the physical environment to the product features extends the shelf life of the food. These articles most frequently mentioned optimization in terms of temperature. For example, they mentioned various technologies that enable optimal cooling within containers or even within department stores (Singh et al. 2018; Raab et al. 2011). Other articles discussed the design of intelligent packaging, which can release additional gases to the surroundings according to the needs of the packaged food; such technologies also can influence air humidity (Bakhtavar et al. 2019; Martindale and Schiebel 2017).

The further field of action within this category is the optimization of shelf life, with six articles assigned to this field of action. In this context, shelf-life optimization is understood as measures that specifically extend the shelf life of the products through various process optimizations or process changes. As an example, we can consider the dynamic calculation of product life combined with storage strategies in order to allow food to be controlled more effectively throughout the entire process (Allen and Schuster 2004). Another goal mentioned in the articles was dynamic pricing depending on the remaining shelf life of the products. In these articles, the remaining shelf life of the products also was recalculated by dynamic calculation based on the current conditions; then, earlier expiring articles were priced lower and put on sale (Kaya and Ghahroodi 2018).

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3.3.4 People

The second most frequently mentioned field of action overall was an increase in network cooperation. In this context, increasing network cooperation reflects the efforts of various network partners to establish optimal cooperative relationships with suppliers, customers, and other network partners. A total of 22 articles and three interviews were assigned to this aspect. Many of these articles assert the view that improved cooperation between the partners not only increases transparency but also, and above all, strengthens the bond between the partners. Meanwhile, it also increases the partners' desire to contribute to process optimization. Alternatively, this improved cooperation may provide partners with the opportunity and security to carry out this optimization themselves (Aggarwal and Srivastava 2016; Alberti and Belfanti 2019; Kouwenhoven et al. 2012). Such optimization may be done for financial and strategic reasons within the cooperation. A social component also plays a role in very close business relationships (Devin and Richards 2018). Three articles within this classification explicitly address cooperation in developing countries while focusing on small farmers and small markets. They show that, especially in this context, a strong relationship can improve the position of the weaker network partners and, thus, strengthen their ability to tackle process efficiency and loss reduction (Alarcon et al. 2017; Markelova and Mwangi 2010; Tsuchiya et al. 2015).

Mindfulness is a further field of action assigned to the group of people. Mindfulness in this context refers to efforts to sensitize all network partners, the company workers, and the end customer to the special features of food while increasing awareness about product wastage. Five articles were assigned to this field of action. The examined articles showed that increased awareness among management, employees, and end consumers leads to an understanding that waste can be reduced by more careful product handling (Kouwenhoven et al. 2012; Alamar et al. 2018). Furthermore, this increased awareness promotes employee commitment to approach the problem and to make creative suggestions for improving the situation (Kouwenhoven et al. 2012; Al-Madbouh et al. 2019).

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The third field of action within this group is consumer satisfaction. In this context, consumer satisfaction is understood to include efforts that are primarily designed to meet specific customer requirements, thus reducing waste at the customer level. Two articles were assigned to this field of action. One study mentioned that specific offers, such as home delivery or sales offers (e.g., cook boxes), fulfilled certain customer needs, and through this orientation the customer tends to waste less (Kouwenhoven et al. 2012; Pan et al. 2017).

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3.4 Discussion

The fields of action presented hold varying relevance for different actors within the food value chain. Considering framework conditions is particularly relevant for actors at the regulatory level. For example, the adaptation of regulations, as they apply in the European Union for certain products, should always consider the effects on losses. Similarly, subsidies and other financial support for companies should be adjusted in terms of their effects on losses. Weaker actors should be supported, especially in developing countries. As shown, these tools can be used to empower small- and medium-sized enterprises in particular, making them more effective in their process execution while achieving lower loss rates. The fields of action of the other groups are mainly relevant for active players in the food value chain. Here, however, the relevance depends partly on the position within the value chain. When it comes to developing future measures, producers and logistics service providers especially should consider the fields of action of the process group for themselves. The group of physical characteristics concerns all active actors in the value chain, as improving both shelf life and the product environment can bring added value by taking into account the product's physical properties at all points in the value chain. The people-related fields of action have to be considered separately. Mindfulness is to be considered at all points of the value chain, as increased care of the products under consideration can reduce losses. Customer satisfaction, on the other hand, becomes especially relevant for the actors at the end of the value chain as they are in direct interaction with the customers. Network cooperation, as a field of action, is also relevant for all active actors within the value chain and should be given high priority in the planning and design of measures against food losses.

The results presented summarize the current state of the scientific research in the field of food loss reduction and provide added value for science and industry in this area. For those seeking to develop measures to reduce food losses, the presented systematization offers practitioners an overview of the objectives with which successful measures against food losses can be generated. Many of the presented fields of action refer to internal company processes. Concentrating on these fields of action will increase resource efficiency within the company and, therefore, also assist in reducing food losses within

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the entire network. However, there is also the risk of losses being shifted to the previous network partners due to improvements in the later stages of the value chain. This effect is particularly problematic in the context of internationally networked value chains originating in developing countries. Due to the unequal balance of power between the partners involved, the weaker partners in developing countries often bear an additional burden. The analysis presented has shown that many authors agree that an effective reduction of food losses within the entire network can be achieved primarily by creating transparency and improving cooperation within the network. This approach does not simply shift losses, but rather minimizes weak points while reducing losses through increased cooperation. Because increased cooperation at eye level strengthens the weaker partners in the network and can make them economically more successful in the long term, this approach can also ensure supply security within the network. This approach not only reduces losses but also strengthens the network in the long term.

Overall, the fields of action are not necessarily selective; there may be overlaps of measures across several fields of action. For example, measures that are introduced in the early phase of the value chain, e.g., through more effective transport management, also influence later warehouse processes most of the time. Packaging management is also closely linked to transport optimization. Meanwhile, correct loading ensures adequate packaging of food during transport. As already mentioned, the use of various technologies is also possible in many individual fields of action. This area includes tracking and tracing, as well as the general use of IT and related data analytics methods. These technologies almost always create an improved general information base. Combining technology with an openness to share this information with value-added partners in the network relates to the transparency field of action. In general, it can be said that increased transparency in almost all fields of action will have positive effects. As such, it can be concluded that increased transparency has the greatest added value within a holistic approach to reducing food losses in value chains.

Developing countries face a hunger problem and a difficult supply situation, requiring close attention when categorizing into fields of action. One way to strengthen the local economy and thus improve the availability of financial resources for food procurement

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would be to increase the participation of actors in developing countries in international value chains. Despite other problems, such as general trade restrictions and inadequate trade routes, improvements can be achieved by taking the fields of action described here into account. At the same time, overall productivity and the availability of food for the local market can be increased by avoiding food losses. Support at the administrative level is particularly effective for small farmers and small enterprises. In this case, however, it must be remembered that these measures should be used with caution, i.e., exclusive financing of measures. Without effective long-term implementation, training and knowledge transfer to the small entrepreneurs concerned cannot be sustainable. In addition, the issue of quality management is particularly relevant for actors in developing countries who aim to participate in international value chains. In many cases, the problem is that quality standards cannot be achieved, and thus, unnecessary losses occur on the export route. In this sense, quality management takes on critical importance in developing countries. Furthermore, it should be noted that transport optimization is also a major challenge in developing countries due to a lack of transport means and suitable containers. As a result of incorrect transport loading, many products are lost, especially in the early stages of the value chain. To implement this area of improvement, it is essential not only to have the technical equipment but also the personnel capability in ensuring adequate food handling. In this case, the focus on the criteria is particularly strong. Employees require training to bring them closer to the specifics of traded food, a target-oriented measure. The use of sensible technologies also holds considerable potential for developing countries.

The analysis of the derived fields of action shows that the fields of action differ not only in terms of their sphere of action, but also in terms of their extension across actors and in terms of the management levels applied. Therefore, the individual fields of action can be classified into schema between strategic and operative application. They may also be distinguished by their separation between internal company application and cross-company application. As a result, the fields of action in the framework conditions group can be defined as strategic fields of action. Financial opportunities are usually given at the individual company level. Regulatory requirements typically apply to or involve

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overarching processes and are therefore more likely to be classified at the cross-company level. The fields of action of the people group, however, are to be assessed differently. Consumer satisfaction involves a field of action that is applied within a company and can include both strategic and operational measures. Network Cooperation always contains cross-company measures and therefore can be assigned at the cross-company level. Within this field of action, however, both strategic and operative measures are combined. The mindfulness field of action is to be placed on the operative level, because here, above all, training and other operative awareness-creating measures are included. Mindfulness can be achieved both within a company and through cross-company measures. Among the physical criteria group, neither physical product features nor shelf-life optimization are applied internally or across companies exclusively. Both can be addressed on both levels by suitable measures. Measures in the field of shelf-life optimization are primarily operational, in that they are mainly organizational measures. The field of action involving physical product features, on the other hand, can be implemented both through operational and through strategic measures, and it is thus positioned between the two.

With regards to the process-oriented fields of action group, the results also reflect a heterogeneous situation. Network structure is a strategic field of action, which is addressed both within a company and through cross-company measures. Warehouse management is to be classified on the internal company level and includes both operative measures and strategic measures, such as layout planning. In most cases, quality management is an internal field of action, but there are also cross-company measures. Quality management is also classified at both the operational and strategic levels. Packaging management is an internal company function those functions almost exclusively at the operational level. According to the analyses, transport management is also represented both on the internal company level as well as on the cross-company level. Most of the measures mentioned for this field of action can be classified at the operational level, but there are also some strategic measures proposed within this field of action. Finally, the transparency field of action is to be mentioned. As already mentioned, transparency at all levels should be addressed in a meaningful way. Here, it should be noted that a holistic creation of transparency can only be fully achieved through the

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interaction of internal and cross-company measures. The situation is similar at the application level. Both operational measures, e.g., by using suitable technologies, and strategic measures are necessary. **Figure 19** illustrates the classification described here.

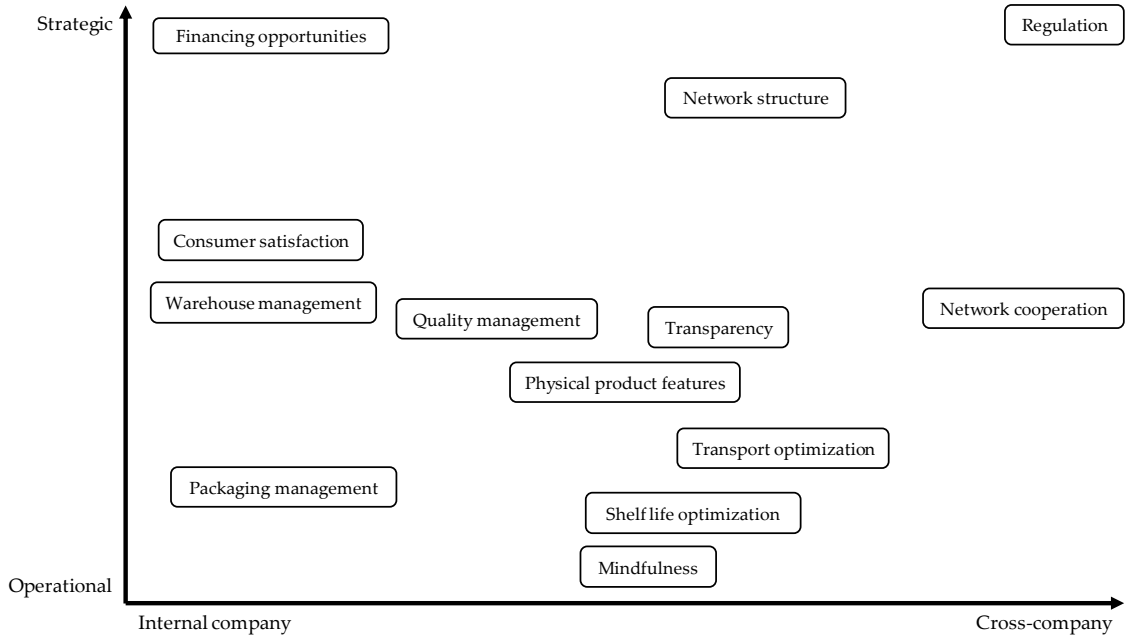

Figure 19 - Classification of the fields of action according to application and company level

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3.5 Conclusions

This study aimed to answer the following research question: Which fields of action are set as objective parameters when developing logistical measures against food losses?

In order to answer this question, this paper first described a basic understanding of logistics. Furthermore, the context was set through a description of the food value chain according to current scientific understanding. By examining 111 articles compiled from a systematic literature analysis and six open interviews with practitioners, criteria were extracted as objectives for the development of measures against food losses. This process resulted in a framework including 13 fields of action in total, all of which could be assigned to four main groups: optimizing processes, framework conditions, physical characteristics, and people. The research question was answered by the framework presented. The analysis demonstrated that a uniform information basis in all fields of action would bring about improvements by optimizing processes, particularly because time is an essential parameter in avoiding food losses.

3.5.1 Scientific and managerial implications

Both scientists and practitioners will benefit from the results presented in this study, which derived and presented fields of action for the development of measures against food losses. Both in practical application and scientific analysis, this framework can be used as an orientation in the development of measures. For scientists, this study provides a scientifically based foundation for developing measures to prevent food losses. This study may provide information in terms of the desired objective and direction of measures. For practitioners, the overview of identified literature in Table 2 holds practical relevance as it can be used as a reference guide to provide suggestions for concrete measures in specific fields of action.

3.5.2 Future research

While analysing the available evidence, this paper identified various areas that required further scientific investigation in order to improve the development and application of measures against food loss.

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(1) What fields of action are best suited as objectives for specific types of companies within the network?

Based on the overview presented in this study, the question arises as to whether or not it is suitable for certain types of companies to focus on specific fields of action as objectives. Some authors address the position or function of the respective companies, but a structured examination of this question is missing. A systematic exploration of these interconnections could add value in practice.

(2) Are certain fields of action suitable as objectives for specific maturity levels in companies in terms of food loss management?

A further question arising from the results of this study is whether the use of certain fields of action as objectives is more suitable for companies at the beginning of their activities in food loss management versus those that have already reached a certain standard. A science-based investigation could create added value for companies; by examining such a hierarchy, businesses could then focus more specifically on suitable objectives, depending on their previous food loss management activities.

(3) How relevant are the fields of action assessed in practice and to what extent can they be compared with the frequency with which these fields of action are treated in science?

A comparison of the relevance of the fields of action found with the requirements in practice would be a relevant continuation of this study. Such research could also result in a need for further action by the scientific community in order to focus on and examine certain fields of action more closely.

(4) As objectives, which fields of action have a particularly strong effect on network partners in developing countries?

As described above, international food logistics has developed into a globally networked system that in many cases originates in developing countries. Based on this fact and derived from the results presented here, the question arises as to how partners in

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developing countries can be encouraged and supported. Partners in developing countries often are dependent on partners in industrialized countries. In many cases, this dependence means that issues, such as process efficiency and food loss management, are not on companies' agendas due to lack of available resources. The high relevance of the network cooperation field of action is indicative of this situation. In order to improve the situation of partners in developing countries in a sustainable manner and make them equal partners in international trade relations, researchers could investigate specific fields of action as objectives for the development of measures.

(5) When creating a uniform information base in a concrete value chain, which information is needed, and which actor should provide it?

Many of the articles outlined above highlight the great importance of a consistent information base. Future research could analyse how such an information base could be designed across a network. This inquiry raises the question of which information would have to be provided by which actors. Further studies are needed into how to create incentives for actors to provide this information for the general benefit, even if the company cannot quantify this benefit for itself in the short term.

3.5.3 Limitations

In conducting this study, the researchers paid special attention to minimizing their individual influences. Nevertheless, this study faced some limitations, which are addressed in more detail below. Borrowing from Nitsche and Durach (2018), the approach pursued in this study combines practical and scientific statements in order to present the broadest picture possible. This research followed this approach by conducting a systematic literature analysis and by interviewing practitioners. However, the sample of practitioners was exceedingly small compared to the articles included from the systematic literature analysis. Consequently, the results are strongly influenced by the theoretical perspective. Regarding the systematic literature analysis, two databases were used, Business Source Complete (by EBSCO) and the Social Science Citation Index (SSCI) database (by Web of Science). The integration of further databases could have added further articles to the data collection, which would have created additional value.

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However, the selected databases contain many journals relevant to this topic, thus minimizing the risk of having missed relevant literature. Finally, a single researcher read the articles remaining after applying the inclusion and exclusion criteria, noting the criteria addressed in each one. This procedural step depended strongly on one person and could therefore have been influenced by their perspective. This issue was addressed by applying qualitative clustering, with two additional scientists involved in the process.

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4 Article 2

Title:

"DEVELOPMENT OF A READINESS ASSESSMENT MODEL TO EVALUATE ENGAGEMENT WITH FOOD LOSS MANAGEMENT IN LOGISTICS"

Presented at

14. AIRL-SCM CONFERENCE, https://www.airl-scm.com/lesactesrairl2022

Submitted version. Presented as: Kleineidam, Julia; Coll, Angelica; Straube, Frank (2022). DEVELOPMENT OF A READINESS ASSESSMENT MODEL TO EVALUATE ENGAGEMENT WITH FOOD LOSS MANAGEMENT IN LOGISTICS. At 14. AIRL-SCM CONFERENCE, Available here: https://www.airl-scm.com/lesactesrairl2022

4.0 Positioning of this article in the context of this dissertation and the logistic management model

For the purpose of this dissertation, it is necessary to accurately understand the current situation of organizations in East African food value networks in order to consider them in the development of the logistic management model. From this analysis, it was found that the majority of local organizations are unable to quantify food losses and also have little awareness of how to systematically address loss reduction. From this it could be deduced that for a model to fit the study region, it is necessary to start with an assessment in which the organizations analyse their own status in order to gain an entry point into addressing this issue. This so-called readiness assessment is developed and explained in this article. It represents a core of this dissertation's own approach and is incorporated into the initial screening of logistic management model.

At the time that work was done on this dissertation for this article, the terms food logistics network, food supply chain and food value network were used synonymously. For this reason, this article refers to logistics networks. In the context of this dissertation, this means the same as the food value network, which was defined in chapter two. This article also refers to food loss management. During the genesis of this dissertation, the more concrete term food loss reduction management was chosen and further used.

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4.1 Introduction

With its 17 SDGs, the UN has set itself the goal of making the world a fairer and more sustainable place by 2030. Goal 12 aims for 'responsible consumption'; more specifically, sub-goal 12.3 states: "By 2030, halving per capita global food waste at retail and consumer level and reducing food losses along the production and supply chain, including post-harvest losses" (UNITED NATIONS 2015b). Since the SDGs were formulated, six years ago, there has been no scientific evidence that the world is decisively closer to achieving this goal. There are promising approaches to food loss (FL) prevention in both practice and science (Nitsche et al. 2018; English 2019); however, for the most part, these have not yet been adopted by the vast majority. If one considers this factor, it is questionable whether a clear understanding of the relevance of this problem already exists across the industry and communities (Garske et al. 2020; Aldaco et al. 2020). Until there is a clear understanding of the problem among companies and consumers, it will be much more difficult to achieve the above-mentioned goal. Furthermore, different logistical measures against food loss require a certain level of knowledge and readiness within the organization (Weidner et al. 2019). However, there is no instrument to assess the readiness level of an organization in order to make a decision on the implementation of food loss management.

When looking at the problems in the current body of research, it is noticeable that most of the latest studies focus on approaches in industrialized countries. Highly technical solutions such as forecast algorithms and intelligent packaging are discussed (Nitsche et al. 2018). However, value chains in developing countries and the link between industrialized and developing countries are not considered very much (Sharma et al. 2021; Närvänen et al. 2021). Many international food supply chains originate in developing countries. Looking at the analysis of Gustafsson et al. (2011), it is evident that developing countries, in particular, have high loss rates in the early stages of the supply chain (Gustavsson et al. 2011). Since the UN target described above explicitly includes post-harvest losses, these parts of the value chain must also be explicitly included in finding solutions. This fact raises the question of whether the results of the previously

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described studies can be applied to developing countries or whether other approaches need to be developed in this context.

Awareness and readiness are important steps in tackling the problem, which is why it should be examined at this stage how far the problem has already reached the actors in the value chain and how they incorporate this topic into their daily actions. This will also provide an insight into the loss rates of the individual stages. Ideally, these results can be used to directly deduce measures that contribute to reducing losses and, thereby, to meeting objective 12 of the SDGs (UNITED NATIONS 2015b).

In order to address such a question, it is necessary to compare and contrast the conditions in the two parts of the value chain. Ethiopia, as a representative nation of the developing countries, and Germany, as a representative nation of the industrialized countries, are suitable for this comparison.

Ethiopia holds a special position among the African countries. Besides a change of power unique in African history in 2018, this country is characterized by constant economic growth rates since 2004 according to World Bank data (World Bank 2019). At the same time, it remains one of the countries with the highest food imports in the world due to the humanitarian situation in parts of the country (Blome 2016). Despite periodical food shortages that the country is facing, food losses seems to be a foreign topic with little public attention and no national strategy (Federal Democratic Republic of Ethiopia 2016; The Federal Democratic Republic of Ethiopia 2010). Having such characteristics, Ethiopia can be regarded as an example of a least developed country as well as an emerging economy (UNEP 2018; Minten et al. 2021).

Germany has been a benchmark in the field of logistics for years. The World Bank's Logistics Performance Index has regularly ranked Germany first since 2014 (World Bank 2018). Therefore, Germany can be used as an example of an industrialized nation. However, there are also extensive challenges in food logistics in Germany. Above all, increased customer requirements are driving the German food industry to take new paths. Specifically, mindfulness towards food and how to deal with food loss is not always in

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focus. In some cases, the urge to fulfil customer wishes leads to the deliberate waste of food. As a result, the German government presented a new ‘national strategy to reduce food waste’ (German Federal Ministry of Food and Agriculture 2019). This shows that there is still a long way to go to meet the SDG’s objectives.

The comparison between the countries presented allows us to answer the question of how awareness for food losses differs. In addition, best practices can also be identified by which actors from both countries can learn from each other and optimize their own processes. This results in the following research question:

RQ1: How does addressing the issue of food loss reduction differ between German and Ethiopian companies?

Furthermore, the aim of this research is to develop a systematic awareness assessment tool based on the identified level of awareness in the investigated companies, which answers the second research question:

RQ2: How can companies be supported in determining their own level of readiness regarding the topic of food losses to be able to independently develop solutions for their own context?

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4.2 Theoretical background

4.2.1 Definition of essential terms

This paper follows the understanding of food logistics as formulated by Nitsche and Figiel (Straube et al. 2016). According to this, food logistics includes "the planning, management and control of the value network of food products from the source of raw materials to the end customer. The focus is on the efficient processing of customer orders using information systems, technologies and management concepts, with special emphasis given with regard to high article-specific quality and safety requirements for perishable goods in various temperature ranges." Straube, Nitsche and Figiel identified the reduction of food losses as one of the most relevant trends in food logistics for the coming years (Straube et al. 2016).

In the literature, different definitions of the terms 'food loss' and 'food waste' are used. These definitions differ in terms of the relationship between the two terms, but also in terms of the general understanding of how these terms are used (FAO 2013; Gustavsson et al. 2011; Papargyropoulou et al. 2014; Parfitt et al. 2010). There are even more extensive definitions, which, for example, include all excess consumption that exceeds a person's basic nutritional requirements as food waste (Smil 2004). In the context of this paper, the term food loss is used as defined by the High-Level Panel of Experts on Food Security and Nutrition of the European Union (HLPE). The HLPE defines food loss thus: "Food losses (FL) refers to a decrease, at all stages of the food chain prior to the consumer level, in mass, of food that was originally intended for human consumption, regardless of the cause." According to this understanding, food waste is the loss of food at the consumer level. Since the focus of this paper is not on end consumers, these losses are not considered (HLPE 2014).

4.2.2 Food loss in logistics networks

Food losses occur at all levels in logistics networks and are multi-faceted and different not only depending on their occurrence in the network in terms of their causes, but also differ in terms of the level of development of the country in which this function is

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performed. In relation to the operational functions in a food logistics network and the level of development of the country, the following **Table 3** shows examples of causes of food losses.

Table 3 - Causes of losses in food value chains (Nitsche et al. 2018)

Value Chain Stage	Developing Countries	Developed Countries
Harvesting and post-harvesting	• weather-related loss • suboptimal harvest period • damage of crops • inadequate infrastructure • low level of automation • defective harvesting equipment • lack of qualified personnel	• weather-related loss • over-production • damage of crops
Food processing industry	• transformational processes • contamination	• transformational processes • production failures • technical issues
Warehousing	• low storage capacity • inappropriate storage conditions and cooling systems • long distances to warehouses • warehouse usage not aligned to customer demand	• technical malfunction of cooling systems • manual errors in cooling regulation • inappropriate storage conditions
Transportation	• inadequate infrastructure • inappropriately equipped transport vehicles • low transportation safety for perishable goods • unreliable transport packaging • inappropriate load securing	• long throughput times • long transport distances • delivery delays • overloading of terminals • inadequate temperature measurements • unreliable transport packaging
Retail	• lack of cooling systems • inappropriately equipped storage and sales areas	• inaccurate sales forecasts • uncertainty regarding date indications

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	• unhygienic conditions	• inappropriately equipped sales areas • inefficient optimization efforts • promotions and discounts
Packaging	• lack of packaging knowledge • inappropriate packaging for transportation and storage	• large packaging units • defective packaging • inefficient packaging design
Processes	• lack of holistic view of value adding • processes in food value chains due to profit optimization • lack of communication between food value chain actors • inefficient processing processes	• high complexity of value-adding processes • lack of holistic view of value-adding processes in food value chains • lack of communication • lack of transparency along the food value chain

Various studies have looked at how food losses can be reduced through logistics measures. In their meta-analysis, Nitsche et al. (2018) created a systematization of the approaches, which can be found in **Figure 20**.

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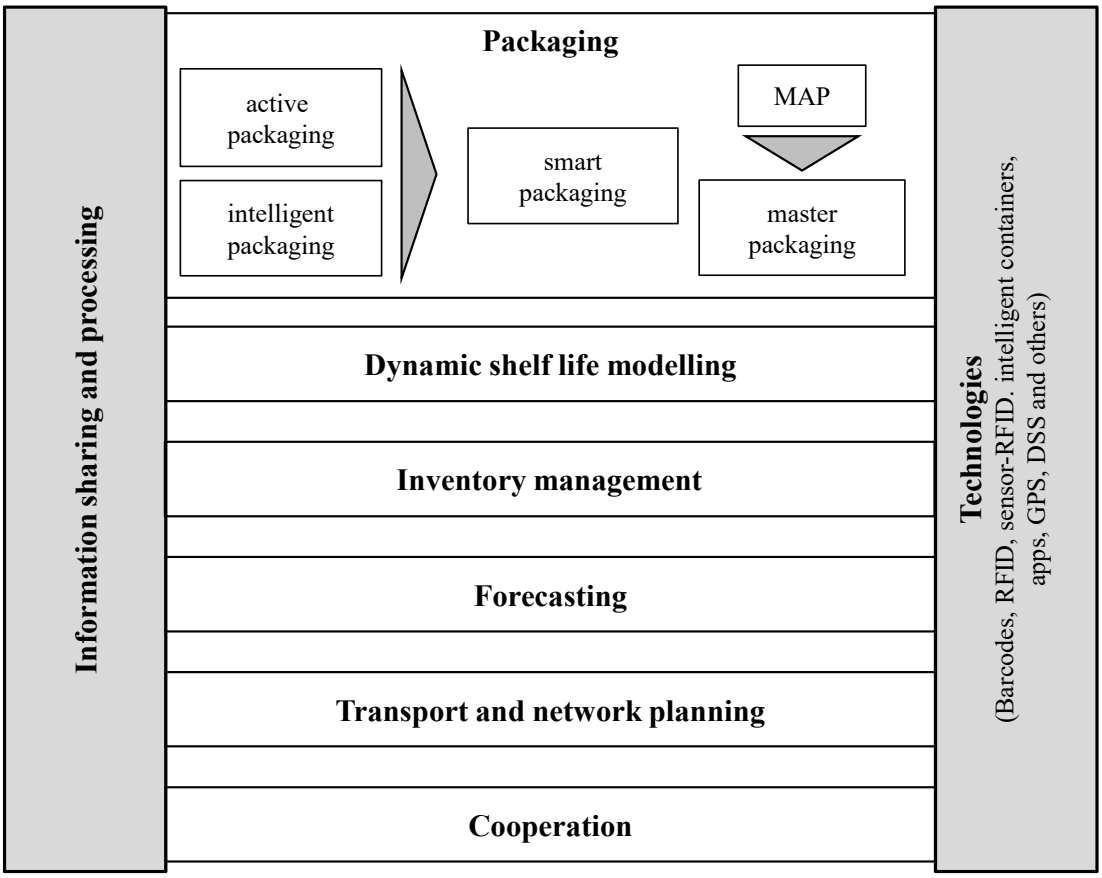

Figure 20 - Food loss management framework (Nitsche et al. 2018)

From this overview, it can be determined that most of the measures have a technical reference and assumed a relatively high level of technological development of the implementing organization (Wang et al. 2012; Xiao et al. 2017; Brewster et al. 2017). The objective of most of the measures found in the literature therefore address the causes of food losses in industrialized countries listed in Table 3 and are discussed for those conditions (Azuara et al. 2012; Vanderroost et al. 2017; Strotmann et al. 2017; Mercier et al. 2018). Little attention is paid to the transfer or application of these measures in developing countries, as well as only limited scope in the literature discussing measures that directly address the causes listed above in Table 1 for developing countries (Martens et al. 2012).

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In the following, an introduction to the relevant basics for trend analysis in food logistics is presented, which form the basis for further considerations regarding the handling of the topic of food loss management within the scope of this article.

4.2.3 Dimensions of logistics to classify logistics trends

Since food loss management is considered a trend in food logistics, the question arises as to how trends in food logistics can be classified. In their trend analysis on logistics, Handfield et al. (2013) define five dimensions that are relevant when considering trends in logistics: Employees, Processes, Technology, Network and Strategy (Handfield et al. 2013). Straube, Figiel and Nitsche specify these dimensions regarding food logistics. The five dimensions are defined in the context of this study and linked to the topic of food loss management.

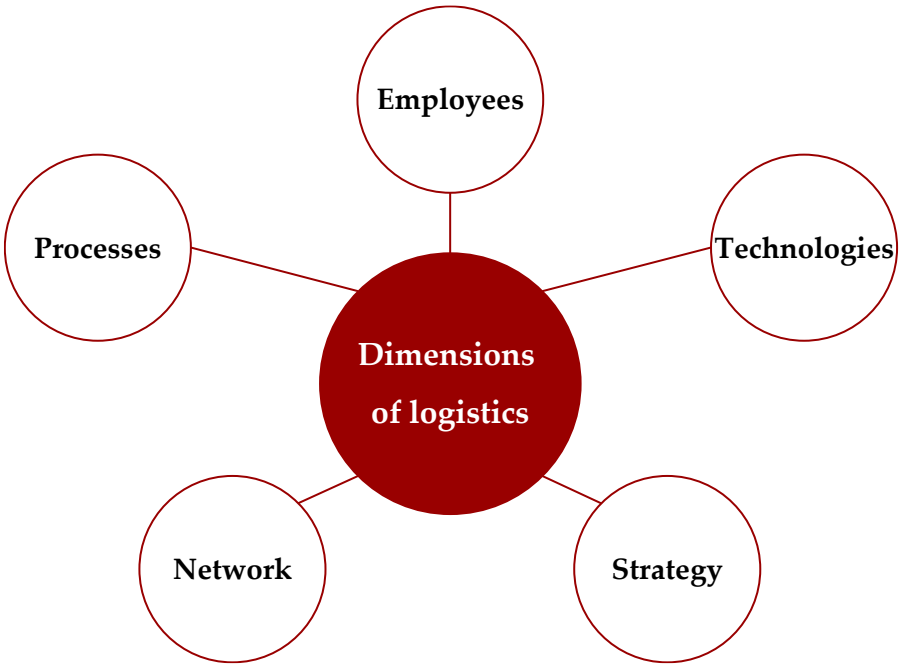

Figure 21 - Dimensions of logistics

4.2.3.1 Employees

Organizations must be able to adapt quickly and make adjustments to respond to unforeseen changes in a challenging environment. A responsive culture is based on highly professional and well-trained employees. Particularly with regard to food, high demands

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are placed on the knowledge and behaviour of employees. In particular, wrong behaviour in handling food by employees is a reason for losses. They are at the core of any business, and leading companies take talent management very seriously. The goal of this is to enable employees to respond appropriately to difficult and unstructured situations. For many of those companies who are not business leaders, the shortage of qualified employees is the overall biggest challenge for the future. Leading companies are concerned about their employees responsible for the supply chain, and the HR department is working out common strategies for talent management, clearly specifying this shortage and implementing measures to counter it. One of the strategies is research collaboration with universities to have a presence on campus and build a source of talent. Another approach is to educate potential employees about careers in logistics and to present logistics as an exciting, growing career field to junior managers and students. Furthermore, these companies advise and develop their employees for work in logistics and recruit qualified employees from other areas of the company. They also invest in training and education for high-potential employees to ensure their further development and retention in the company, as well as promoting employees into specific roles that will help them advance (Handfield et al. 2013; Straube et al. 2016).

4.2.3.2 Processes

The more a company grows, the more its success depends on clearly defined policies, procedures, structures and a supportive corporate culture. However, core processes must provide sufficient leeway to adapt to the changing situation or culture. Employees who grasp the corporate culture are challenged through mentoring, guidance, and training and development opportunities. This not only leads to greater employee loyalty, but also builds their skills, paving the way for innovation and new ways of working in a global network. To build a global process that can be adapted to diverse local regulatory, cultural and network conditions, a suitable decision maker is needed who is familiar with the process environment. Due to the specific demands that different foods place on logistics, coordinated processes are important to ensure that all requirements are always considered. Faulty processes are, in many cases, the reason for food losses. Process-oriented

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companies operate with independent logistics organizations. This independence makes logistics an important global process with its own services but adapted to business requirements. Thus, structured decisions regarding the fulfilment of the customer order process can be centrally planned, executed and controlled. Similarly, leading companies need to make outsourcing or insourcing activities and decisions regarding their processes. These decisions, in turn, have an impact on internal and external logistics processes. Depending on the company's objective, planning and fulfilment processes are involved here, for example in the distribution of foodstuffs or in procurement and production preparation (Handfield et al. 2013; Straube et al. 2016).

4.2.3.3 Technologies

Leading companies have recognized that to successfully meet logistics trends, they must leverage technologies that generate new insights, provide transparency and demand an action-oriented corporate culture. Investments in technologies promise the greatest success in implementation when they have a direct link to user requirements, responsiveness to customer requests and value creation. The use of technology facilitates the handling of food on many levels. Nevertheless, incorrect handling or the incorrect use of technology in general can lead to food losses. Leading companies are investing in a solid foundation of robust logistics and supply chain data, ensuring that their data systems can track events and transactions and provide a strong, data-driven analytics foundation. These technologies are the foundation for network optimization, visibility into global material flows and end-to-end integration. By requiring multiple players in the extended global supply chain to have access to the same data, all members of the supply chain are able to contribute to its bottom line. Technologies help integrate planning processes, ensure coordinated responses to global events and provide the foundation for analytics that will become increasingly important for competitive decision-making in the near future. In addition, technologies enable the tracking of events at upstream suppliers and provide real-time updated key figures for the optimization of logistics networks (Handfield et al. 2013; Straube et al. 2016).

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4.2.3.4 Network

Due to interdependencies between supply chains, often globally connected, disruptions in one node can compromise the entire network. Over 70% of all respondents in the study by Handfield et al. consider close collaboration with key suppliers as a measure against disruptions. A key component to creating a resilient logistics network, in addition to understanding the various players, is gaining insight into their capabilities, limitations and connections within the network. Especially due to the many actors involved in food logistics processes, it is highly relevant for food loss management to pay attention to good relationships within the network and, thus, also work together to reduce food losses. Leading companies have moved to disclose even confidential data if it provides a more complete understanding of requirements among key partners, particularly data related to research and development. Another prominent feature is that they are sharing information with more and more members of their supply chains, including upstream suppliers and logistics service providers. The results also show that leading companies are also using cost-to-serve analytics to inform their logistics decisions, for example for future outsourcing processes (Handfield et al. 2013; Straube et al. 2016).

4.2.3.5 Strategy

When dealing with trends in food logistics, a long-term alignment of the corporate strategy to these trends is essential. These include, for example, the development of new markets, innovative business models, corporations or customer segments. These, in turn, have a significant influence on the company's logistics. As customers become more open to these issues, proactive companies are aligning their strategies with new measures, such as monitoring and measuring their environmental footprint, optimized transportation networks, packaging and end-of-life strategies for their products. Companies, thus, can also engage with the environment and society to respond to trends. Joint development of standards with network partners, organizations or government agencies can also be part of the company's strategic direction. In the future, companies will need to partner vertically and horizontally with other organizations in industry initiatives or partner with government agencies, for example, to ensure greater social equity and further reduce CO2

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emissions over time. The study findings of Handfield et al. suggest that leading companies are more likely than others to implement green logistics strategies and to see corporate social responsibility as an important component of their logistics strategies. The human factor has become a central issue, so that companies require their suppliers to comply with globally uniform standards for labour and human rights (Handfield et al. 2013; Straube et al. 2016).

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4.3 Methodology

For the purpose of gaining an overview of the extent to which food losses are already being addressed in the research environments of Ethiopia and Germany, an online survey was conducted among food producing and processing as well as transporting companies in both countries. In addition to the main focus of food losses, the survey also covered the future issues of sustainability, transparency and the increasing influence of e-commerce in the B2B and B2C sectors, which are not covered in detail in this paper.

4.3.1 Selection of the data collection method

An online survey using the Unipark survey platform was chosen as the data collection method for the study. The design of the survey was based on the methodology of the study by Nitsche and Figiel (Straube et al. 2016). The advantages of this method are, in particular, that a large number of people from the desired target group, located in two different countries, can be reached within a short period of time and without significant financial expenditure, and that the collected data are subsequently available directly in digital form. Due largely to the circumstances of the COVID-19 pandemic, no direct interviews could be conducted in either country, which further strengthened the advantages of an online survey.

4.3.2 Structural development of the questionnaire

Regarding the structural development of the questions, mainly closed as well as semi-open questions were formulated. Closed or semi-open questions ensure greater objectivity of the results. In addition, they offer a better possibility to conduct a replication study at a later point in time, if this becomes appropriate (Reinders et al. 2011).

Closed questions are particularly useful for online surveys, as they often result in a higher response rate. In addition, the evaluation of the data is easier with closed questions since the answers given do not have to be coded or clustered. In contrast, in the case of semi-open questions, which allow more creative response behaviour, the answers given must also be coded in order to ensure comparability of the answers.

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For this online survey, nominal, ordinal and cardinal scale levels were used according to the respective questions. For the majority of questions, responses were based on ordinally scaled Likert scales. These response options mostly represent the range between complete agreement and complete disagreement. In addition, numerical values from one to five were assigned to the answer options to facilitate the subsequent evaluation. Generally, when developing the questions for the online survey, great care was taken to ensure that they were used in a targeted manner to answer the research questions. Furthermore, the necessary principle of neutrality was always observed in the process of formulating the questionnaire. The questionnaire was divided into general questions about the respective company and trend-specific questions. The trend-specific questions regarding the food loss trend concerned the application of action items which had been concluded in this analysis by Kleineidam (Kleineidam 2020). Since the current COVID-19 pandemic will have lasting consequences for companies within the food industry and their involvement with issues outside their regular day-to-day business, the trend-specific questions were followed by an optional open-ended question to query individual insights regarding the impact of the pandemic on the food industry. Overall, it took an average of 19.7 minutes to complete the questionnaire.

The analysis was carried out using Microsoft Excel and SPSS version 27. The first descriptive analyses as well as the graphical presentation were conducted in Excel. For further statistical analyses, for example correlation analyses, regression analyses and statistical tests, SPSS version 27 was used.

4.3.3 Sample demographics

A total of 84 participants completed the survey. There were 30 participants from Ethiopia and 54 participants from Germany. In addition to country affiliation, participants were asked about the position of their companies within their value chain. The allocation of the companies to the position of the value chain can be seen in **Figure 22**.

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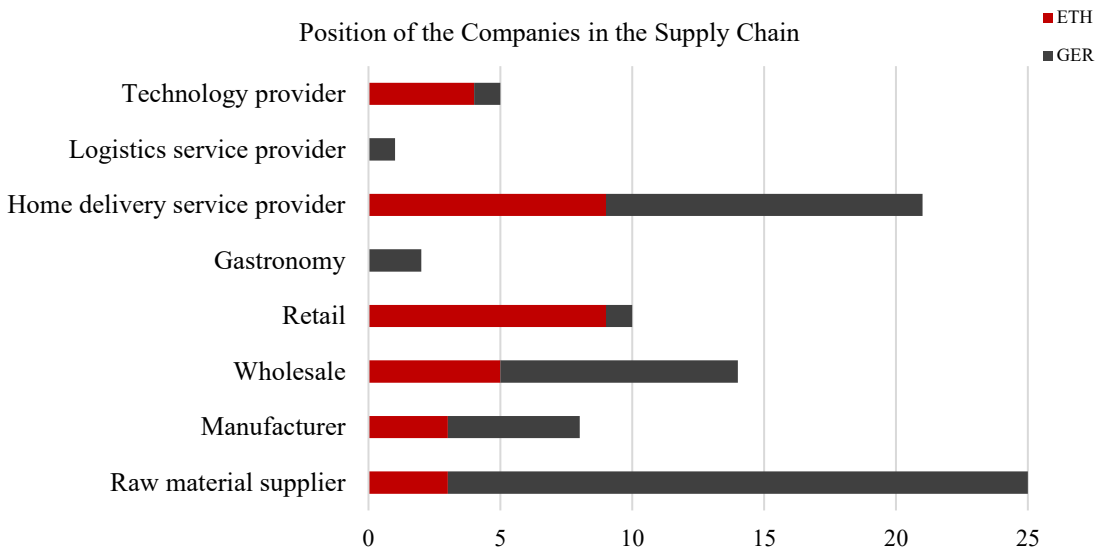

Figure 22 - Position of the Companies in the Supply Chain

Four participants did not assign themselves to any of the stakeholder groups surveyed. The most frequently mentioned category among the German participants was manufacturers, with 45.3% of the responses. The most frequently mentioned actor groups among the Ethiopian participants were gastronomy and logistics service providers, with 33.3% of the mentions. The logistics service provider group shows the greatest similarity in terms of frequency with 33.3% and 26.4%, respectively, between the two groups. No Ethiopian participants assigned themselves to the categories home delivery service provider or technology provider. For this reason, these groups of actors are not explicitly considered further in the following sections.

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4.4 Results and discussion

4.4.1 Descriptive analysis of survey results

As an introduction, the participants were asked how they assess the relevance of food loss management (FLM) for the food industry in general today and in five years. On average, Ethiopian participants rated the relevance today with a scale value of 3.47. German participants rated the relevance today with a scale value of 3.09.

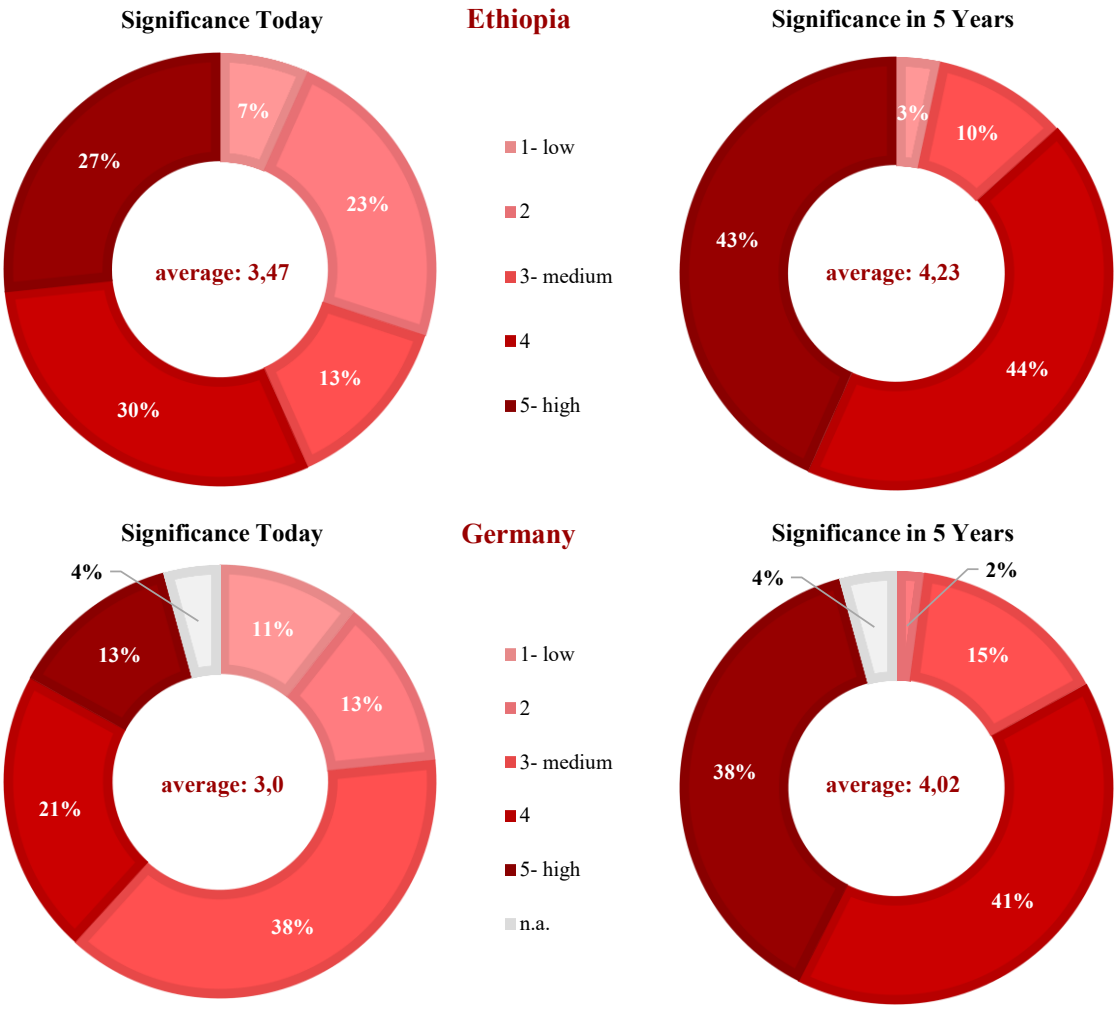

Figure 23 - Relevance of the Food Loss Management Trend in Ethiopia and Germany

These values are not significant after consideration of the test statistics (p value at 0.202 for the current view or 0.504 for a reference value of 0.05). Thus, it can be assumed that

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the relevance of food loss management today is assessed by both groups of respondents as being at the same, medium level. If this assessment is compared with the known figures on the extent of the problem of food loss, it can be seen that the companies do not yet attribute the necessary relevance to the problem. In both groups, the five-year outlook shows an increase in relevance to 4.23 from the Ethiopian experts and 4.13 from the German experts. Again, the test statistics show that the difference is not significant. Thus, it can be stated for the five-year view that both expert groups see an increase to a high relevance equally.

In addition, the participants were asked about the importance of food loss management in their company. Here, the assessments differed significantly. **Figure 24** shows the percentage distribution of both expert groups.

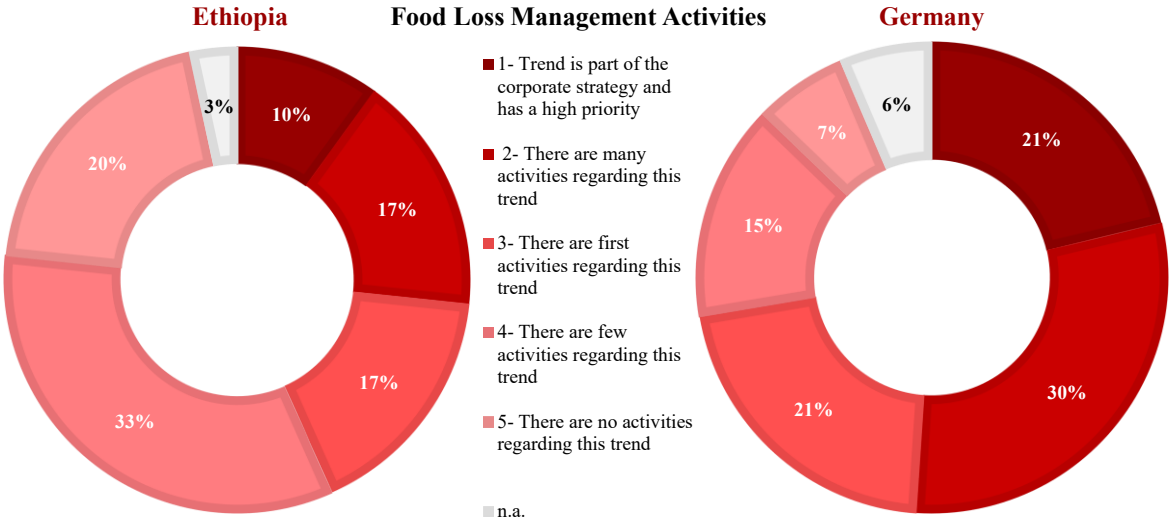

Figure 24 - Food Loss Management Activities

Only 10% of Ethiopian experts stated that they have implemented food loss management as part of their corporate strategy and give the issue a high priority. Twice as many Ethiopian experts (20%) indicated that the company does not undertake any activities regarding this trend. Among the German experts, 21% gave the trend a high priority and only 7% stated that the company does not undertake any activities regarding this trend.

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This picture is strengthened when the answers to the following question in the questionnaire are considered. The question asked what opportunities are seen for the companies through the reduction of food losses. The challenges identified from the literature and the experts' assessment are shown in the **Figure 25**. In addition, the experts were given the opportunity to name further opportunities that they see in the reduction of food losses. No further opportunities were named by the experts, which indicates that the opportunities derived from theory are also regarded as the most relevant in practice.

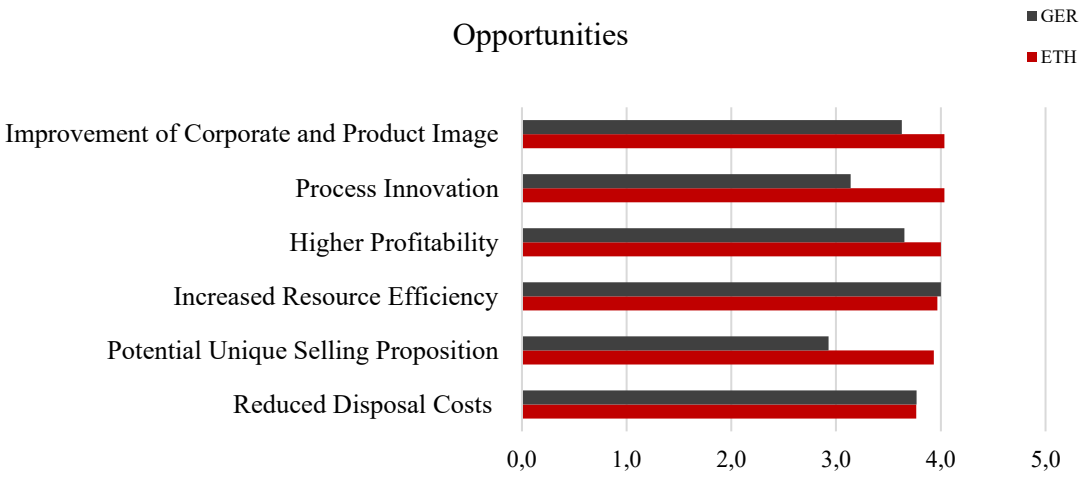

Figure 25 - Opportunities of food loss management

When looking at the figure and the six opportunities, we see that four of the six opportunities are rated as more important by the Ethiopian experts than by the German experts. These differences are significant for the three opportunities 'Potential unique selling proposition', 'Increase in economic efficiency' and 'Opportunity for process innovation'.

Despite an equivalent assessment of the relevance of the trend, the discussion of food loss management is very different between the two reference groups. The results of the opportunity assessment pointed in the same direction. These results suggest that in Ethiopia there are greater obstacles to the actual consideration of the topic in

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entrepreneurial activity, despite an equally high assessment of relevance and a partially even higher assessment of opportunities.

The participants were also asked about these barriers. Analogous to the opportunities in the literature, seven barriers were derived, and the experts were asked to assess their relevance. The experts were also given the opportunity to name further barriers. Four additional barriers were named. It should be noted that only the German experts named further barriers. These were: best before date as a waste-maker, consumer appreciation not monetizable, high degree of automation and acceptance readiness/capacities of social services. The consideration of the additionally mentioned barriers suggests that this result strongly from the basic conditions in Germany. It can be deduced from this that barriers that are considered general can be derived from theory, analogously to the challenges, as also valid for practice.

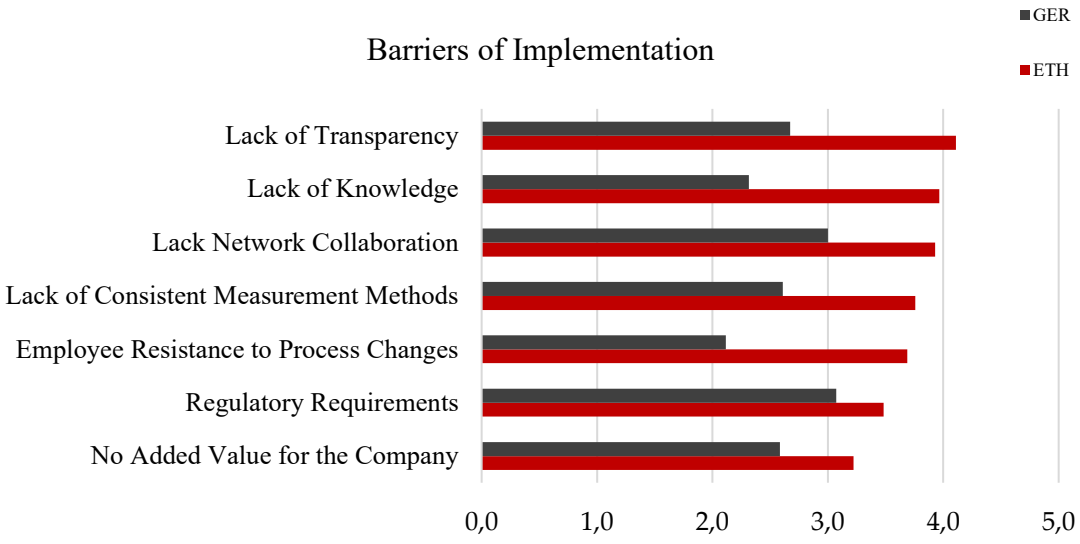

Figure 26 - Barriers of implementation of food loss management

When considering the seven barriers in question, it is noticeable that the Ethiopian experts rated the influence of all seven barriers as stronger than the German experts. This difference is statistically significant for five of the seven barriers. For the two barriers 'No added value for the company is seen from the decision-making level' and 'Regulatory

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requirements generate losses', an equally strong assessment is assumed. It should be emphasized here that with an overarching mean scale value of 2.55, that is, a mean relevance assessment, the barrier 'No added value for the company is seen from the decision-making level' has the lowest relevance of the barriers in question. This underlines the previous findings that companies in both countries are generally open to the positive opportunities of reducing food loss.

The results presented so far strongly indicate that the difference in the implementation of food loss management in the respective companies and the difference in the assessment of the barriers show a correlation. Since the general assessment of the trend is the same, it follows logically that the different strength of the barriers has an influence on the implementation. The barriers in question are, therefore, examined in more detail below.

The greatest difference in the assessment is shown by the barrier 'Lack of knowledge among employees for the implementation of improvement measures. The formation of company-relevant skills and knowledge is a core task of the company to promote engagement with current trends. Accordingly, this barrier represents the 'Employees' dimension of logistics described above. Thus, this barrier shows that the Ethiopian companies surveyed see difficulties in addressing this dimension of logistics with regard to the food loss management trend. However, the appropriate further qualification of employees and the targeted recruitment of qualified personnel are prerequisites for the successful consideration of this logistics dimension.

The barrier 'Lack of willingness of network partners to cooperate' shows the second largest difference in the assessment. The relevance of cooperation with network partners to meet trends in food logistics is reflected in the logistics dimension 'Network'. This is particularly important for food loss management. Without designing cross-actor processes with low losses, losses are merely shifted to another actor with selective optimization measures.

The third largest difference in the experts' assessment is the barrier 'Lack of technology to create transparency about losses in own network'. The lack of use of technology,

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whether due to a lack of resources for the technology or a lack of competencies for its use, reflects the fact that the logistics dimension ‘Technology’ is not sufficiently taken into account when dealing with FLM.

The barrier ‘Lack of uniform measurement methods for food losses’ also shows a significant difference between the observed groups. Uniform measures, standards and guidelines fall under the logistics dimension ‘Strategy’. Companies should be actively involved in standardization processes in order to create cross-company synergies. In relation to FLM, this is above all the question of uniform measurement methods addressed here, in order to bring the different network partners onto the same basis for discussion.

The last barrier with significant differences is the barrier ‘Employee resistance to process changes. As described in the introduction, it is an elementary task of the logistics dimension ‘Process’ to establish structured processes in the company and to involve the employees in them. If employees actively oppose changes in these processes, this is evidence of a failure on the part of the company to give this logistics dimension sufficient relevance and to implement suitable measures to successfully incorporate this logistics dimension within the company.

The explanations given here have shown that, despite the same assessment of relevance, Ethiopian companies face greater challenges that prevent the implementation of FLM. These barriers can be directly linked to the five logistics dimensions.

4.4.2 Derive a readiness assessment model to assess engagement with food loss management

Following this deduction, the question arises as to how organizations must position themselves in the logistics dimensions discussed in order to deal with the barriers described in an appropriate manner, and, thus, respond more effectively to the trend of food loss management. For this purpose, a framework is proposed which shows important aspects of the respective dimensions and offers the possibility to check the readiness level

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of an organization with regard to the described logistics dimensions. **Figure 27** summarizes the proposed readiness level assessment model.

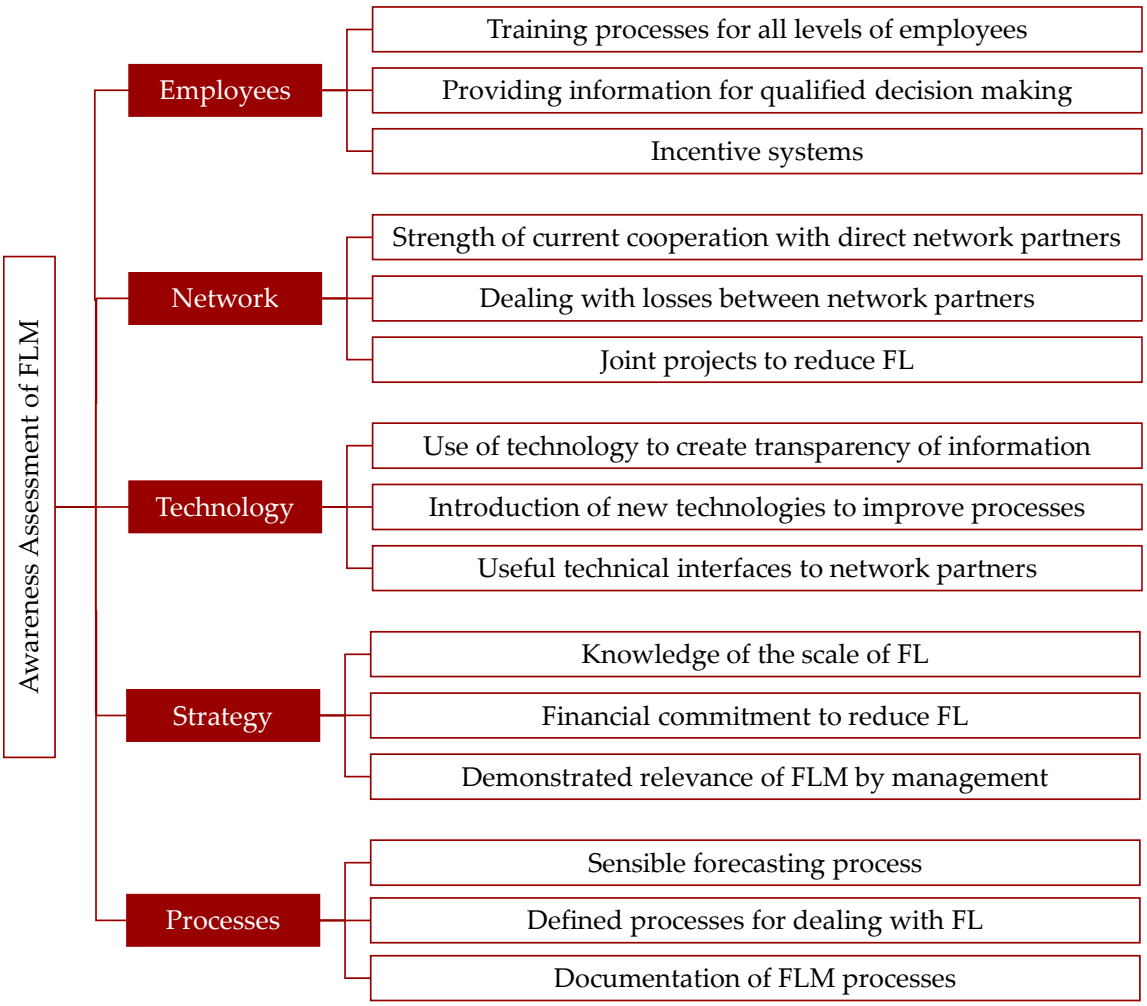

Figure 27 - Readiness assessment of food loss management

In order to increase the involvement of employees and their willingness to contribute to food loss management in a target-oriented manner, an intensive examination of the skills and potential of employees is essential. It is also extremely important to show employees that their potential is recognized and promoted within the company. This applies to employees at all levels. Thus, it can be concluded that established training processes for employees at all levels are a building block for successful familiarization of the employee dimension with food loss management.

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Well-educated and trained employees can only react and respond to new challenges in a reasonable way if they are provided with the necessary information to make appropriate decisions based on it. Accordingly, it is indispensable for the company to provide employees with as much process information as possible at all times to support decision-making. However, a company must do this in a structured process so that the information can also be usefully absorbed and taken into account by the employees. It is, therefore, not only a question of providing sufficient information but also a necessity to pre-process the information in a way that is customized to the employee's level of knowledge and workplace, and to process and present it in a suitable manner.

The third important pillar for the meaningful involvement of employees is the long-term motivation of the employees to commit themselves to the company with regard to food loss management and to participate in the further development of solution approaches. Besides a generally open and positive corporate climate, incentive systems are necessary for increased commitment. These not only increase the motivation of the employees to think about an issue and to get involved in a change process; they also reward additional commitment in retrospect. The knowledge that other employees have already benefited from an incentive system can also motivate others to get involved. The design of an incentive system must be aligned with the processes and structures in the company. This can include financial incentives, internal company awards such as 'Employee of the Month' or other improvements such as additional vacation days.

In summary, the following pillars are proposed to rank the readiness level of a company with respect to the logistics dimension 'Employees':

- Training for all levels of employees
- Providing information for qualified decision making
- Incentive systems

In order to involve one's own network in tackling the challenges posed by food loss management, it goes without saying that, in addition to one's own commitment, the

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willingness and cooperation of the network partners is also necessary. However, a company can create the best conditions at the time to tackle the challenges in a collaborative manner. The strength of the current cooperation with the network partners can be seen as a benchmark and a pillar for this. Companies that do not make an effort to establish strong cooperation in their day-to-day business will not have the opportunity to initiate further projects regarding an improvement of food loss management together with their partners. In particular, long-term relationships strengthen the trust between network partners and make it possible to work together on challenging problems.

Another pillar to consider should be the handling of losses between network partners. Without established processes on how to react to losses in deliveries between partners, a substantial component in the establishment of food loss management is missing. What is needed above all is a common understanding that losses should not be shifted from the own system boundaries to the partners, but that sources of loss at the interfaces should be understood as a joint task and responsibility and that joint approaches to solutions should be sought.

A further statement about the readiness level of a company with regard to the logistics dimension ‘Network’ should be made on the basis of pre-existing or successfully completed joint projects concerning food losses. A company that has already established intensive relationships with network partners and has reacted to noticeable problems and causes of loss through joint projects to overcome these shows itself capable of working successfully with network partners on the one hand and implementing the objectives of this logistics dimension on the other.

Concluding, it is suggested to use the following pillars to classify the readiness level of a company with respect to the logistics dimension ‘Network’:

- Strength of current cooperation with direct network partners
- Dealing with losses between network partners
- Joint projects to reduce food losses

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A company that has successfully positioned itself with regard to the logistics dimension 'Technology' should be able to use suitable technologies to generate information transparency within its own processes. If this is done, it enables fact-based decision-making and a timely response to problems. The use of suitable technologies is, therefore, of essential importance, as information can be provided more quickly and effectively than through manual processing of the information. In addition, the use of artificial intelligence, for example, enables not only the provision of information but also the provision of proposals for action that decision-makers can incorporate into their own considerations.

Additionally, a company's ability to introduce new technologies in a targeted manner should be considered when assessing its readiness levels. The non-introduction of any new technologies shows that companies do not deal with current technology developments and, therefore, do not integrate the potential of new developments into their processes. Nevertheless, the introduction of a technology must be targeted. A technology introduction that has only been made as a result of the current hype around a technology is generally not effective but binds manpower to it and potentially leads to an unnecessary introduction of additional processes. This, then, possibly leads to increased complexity of processes and makes them more error prone. A company with a high level of readiness with regard to this logistics dimension is, therefore, able to evaluate a technology in terms of its potential for the company and its positive contribution to food loss management in this context, and then introduce it in a targeted manner.

In addition to the targeted use of technologies within the company, it is also essential for a company with a high readiness level to have suitable IT interfaces with its network partners. Electronic information transfer is more efficient and less likely to cause errors than manual information transfer. In addition, information with suitable interfaces can be fed into the company's own systems more quickly and can, thus, contribute more efficiently to the company's own decision-making. In contrast, breaks in service due to manual processing are very likely to result in errors.

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Putting it all together, in order to evaluate the readiness level of a company with respect to the logistics dimension ‘Technology’, the following pillars are proposed:

- Use of technology to create transparency of information
- Introduction of new, adequate technologies to improve processes
- Useful technical interfaces to network partners

A company that strives to establish food loss management and to tackle this trend must also position itself strongly with regard to the logistics dimension ‘Strategy’. An important field of action is the general knowledge about the extent of losses in the company. If a company does not make any effort to build up thorough knowledge in this area, it has a particularly low level of readiness with regard to this logistics dimension. In contrast, companies that are fully aware of the extent of losses and their causes are leaders in this area.

Companies that are aware of the strategic importance of food loss management and actively strive for improvement in this area allocate a budget for food loss management. However, these financial resources should be applied in a targeted manner. Thus, a high level of readiness in this pillar is demonstrated not only by the fact that a company provides budget for food loss management but that it combines this with strategic consideration and goal setting.

As a further pillar, a leading company should promote food loss management and a positive culture in this context as a characteristic of its own company. This requires, above all, that the management levels set a good example here and take an active role both through their actions and through their decisions. In addition, the relevance of the topic for the management level should be regularly communicated to the employees as well as to network partners and customers, and this strategic orientation of the company should be made clear.

In order to rank the readiness level of a company with respect to the logistics dimension ‘Strategy’, the following pillars are proposed:

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- Knowledge of the scale of food losses
- Financial commitment to reduce food loss
- Demonstrated relevance of food loss management by management

In order to take the logistics dimension ‘Process’ into account, it is essential to define processes for dealing with food loss in the company and how these losses can be avoided through certain actions. If employees are not given clear processes on how to deal with losses, they will have to find new ways each time or possibly establish their own approaches to solutions that do not necessarily correspond to the company’s objectives. Leading companies in this field should, for example, define processes for dealing with food losses based on the avoidance pyramid (Papargyropoulou et al. 2014). Companies that do not make these specifications lose possible advantages that can be achieved by a certain utilization strategy.

In addition to the necessary definition of processes, these would also have to be documented in a meaningful way. This step, which seems very logical in general, will also lead to undesired processes with losses or even generate them if it is not implemented properly. It is of vital importance that all documentation is user oriented. If the documentation cannot be quickly understood and followed by the users, for example due to language or complexity, this documentation will not fulfil its purpose of establishing the defined processes.

As the third pillar of the logistics dimension ‘Processes’, it is proposed to assess companies in terms of their forecasting processes. Companies should be aware of their sales, especially when dealing with food and its perishability. Thus, non-existent or inadequate forecasting processes promote uncertainty, and can also act directly as a cause of loss. A successful company controls its products via structured forecasts, enabling planning reliability.

As a conclusion, in order to assess the readiness level of a company regarding the logistics dimension ‘Process’, the following pillars are proposed:

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- Define processes for dealing with food loss
- Document food loss management processes
- Establish a suitable forecasting process

The framework provides the opportunity for an organization that wants to strengthen its logistics concerning food loss management to orientate itself in a manner in which a high readiness level already exists in the five dimensions, and in which dimensions the fundamental barriers have not yet been addressed. In this way, transparency is created with the help of this framework so that the company can decide on suitable measures based on it, which reduce the weaknesses of the company.

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4.5 Implications

The presented model provides a definitional framework for the analysis of the readiness level of organizations regarding the reduction of food losses in logistics. On the one hand, the model can be applied directly in practice by actors within the food value chain for self-assessment. In addition, it can also be used by administrative and governmental bodies for decision-making. Furthermore, it also contributes to scientific research and, thereby, expands the knowledge base in this research area. Below, the effects for each of the described groups of actors is discussed in more detail.

Actors in the food value chain should look at the presented areas in their own analysis to get a first self-assessment. This helps above all to get started with the topic and to develop a feeling for one's own status. As described above, many actors within the food value chain, especially in developing countries, hardly know what their own status is regarding the degree of addressing the issue of food losses within their own organization. Consequently, this model can provide an introduction to the fundamental discussion of the topic. Only with a corresponding transparency about one's own status, problems and potentials can food losses be effectively reduced.

Administrative and governmental actors can use the model to check the current situation within an organization to be supported for planned support and funding programs. The model was derived on the basis of company data, but because it is linked to the dimensions of logistics it can also be applied in general to organizations that organize food logistics structures. Particularly in developing countries, this also includes larger aid organizations of the UN or other NGOs.

The research community is dealing with the topic of food loss management in many dimensions. The present work provides a contribution to closing the research gap with regard to the question of how to get started with an active prevention of food losses in logistics by actors of the food value chain.

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4.6 Final remarks

This paper deals with the question of the extent to which the approach to the reduction of food losses differs in developing countries, exemplified by Ethiopia, and industrialized countries, exemplified by Germany. It was found that German and Ethiopian companies consider the relevance of the issue of food loss to be equally important. In contrast, there is a difference in the implementation of measures against food losses. The analysis showed that Ethiopian companies have established only a small number of activities against food losses in their own structures. Based on this, a model was derived and proposed that allows organizations to assess their own readiness level with regard to addressing food loss reduction.

The postulated model not only provides companies with the possibility to assess their own readiness level; governmental organizations or NGOs can use the proposed model to analyse the structures for projects and to define project priorities.

By enrolling the model in case studies as examples, benchmarks can be derived for the individual pillars of the model and, thus, concrete control variables can be established for assessing the readiness level.

The model is naturally subject to some limitations. The proposed model was derived from the statements of Ethiopian and German experts and their statements about the markets. The participants represent a relatively small sample of stakeholders from the two countries and are not a representative sample. However, the model can be applied globally, as the barriers prevailing in Ethiopia correspond directly to the logistics dimensions presented here, which generally apply to addressing trends in logistics. Nevertheless, the application should take into account that the characteristics of the relevant barriers might differ in other application markets. Based on the derivation, however, it is assumed that the application can be used for developing countries with a similar level of development. The proposed model is also limited by the fact that it only provides a theoretical framework. A concrete design of a question-based application tool that enables a concrete recommendation for action from the assessment of a company’s

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readiness level is a subsequent step that must follow on from the work presented here in order to fully achieve the goal formulated at the outset.

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5 Article 3

Title:

"Distinguishing Organisational Profiles of Food Loss Management in Logistics"

Published in

Logistics 2022, 6(3), 61; https://doi.org/10.3390/logistics6030061

5.0 Positioning of this article in the context of this dissertation and the logistic management model

For the objective of this dissertation, to give an organization in an East African food value chain network recommendations for logistical measures to reduce food losses, it is necessary to use the previous results. More precisely, it is necessary to derive organizational profiles based on the readiness assessment, for which recommendations for action are then possible. In the context of the analysis carried out here, these are brought together with the fields of action developed in this dissertation. This is done on the basis of a survey of local organizations.

At the time that work was done on this dissertation for this article, the terms food logistics network, food value chain and food value network were used synonymously. In the context of this dissertation, this means the same as the food value network, which was defined in chapter two. This article also refers to food loss management. During the genesis of this dissertation, the more concrete term food loss reduction management was chosen and further used after the articles.

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5.1 Introduction

A growing awareness of sustainable consumption has been observed among consumers for some time (Wojciechowska-Solis and Barska 2021). This awareness relates not only to, for example, regionality and reduction in CO2 emissions, but also increasingly to the demand for food value chains to have as few losses as possible (Straube et al. 2016). This trend is also reflected in the goals of the global community, which specifically stated in Target 12.3 of the Sustainable Development Goals of the United Nations that food losses should be halved worldwide (UNITED NATIONS 2015a). Although this target suggests that there is a clear picture of the amount of loss, such information is not available. Accurate data are lacking due to a lack of awareness among stakeholders and the fact that neither a standard for recording losses nor a uniform definition of the delimitation of losses has been established (United Nations Environment Programme 2021). The Food and Agriculture Organization of the United Nations and the United Nations Environment Program have taken the first steps towards outlining a clearer quantitative picture of global food losses and waste with the Food Loss Index and the Food Waste Index by compiling many publicly available sources with estimates and surveys (FAO 2021). In recent years, several scientists have investigated various measures that can contribute to the reduction in lifecycle losses in logistics processes (How et al. 2020; Magalhães et al. 2022; Nitsche et al. 2018; Magalhães et al. 2022), particularly the implementation of techno-logical solutions that have the potential to reduce food losses (Brewster et al. 2017; Wang et al. 2012; Chuang et al. 2017; Chimphango and Görgens 2015; Pinior et al. 2015; Sarpong 2014).

However, these significant steps do not provide a complete picture that companies and other actors in the food value chain can use to guide their food loss management (FLM) activities. Minimal focus is being placed on how organisations in food value chains in general are currently addressing FLM and how measures against food losses are selected on the basis of these conditions. Without an understanding of the extent to which organisations have already gained experience in this area, it is difficult to develop measures tailored to the given circumstances in an organisation.

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Nonetheless, to address the issue and provide food value chain actors with a way to determine where they stand, a qualitative readiness assessment model of an organisation's FLM was developed (Kleineidam et al. 2022). Based on this model, the question arose as to the actual readiness level of actors in the food value chain in practice. Furthermore, on this basis, it was determined on which fields of action of FLM in logistics these actors should focus their activities on the best case, which resulted in the following research questions:

RQ1: How can organisations of food value chains be differentiated in terms of their readiness levels with regard to the implementation of FLM in logistics?

RQ2: How can this distinction be used to derive recommendations for action for the future implementation of FLM in logistics?

To answer these questions, the theoretical background is presented below. Subsequently, the methodology used for data collection via an online survey and the data analyses using a cluster analysis are described. The five resulting clusters are analysed and explained in the results section. The implication section derives recommendations for action for the company characteristics identified in the clusters.

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5.2 Theoretical background

This section presents the theoretical background needed to understand the research presented in this paper.

5.2.1 Food loss management in logistics

Food logistics is defined as:

'The planning, management and control of the food value network from the source of raw materials to the customer. The focus is on the efficient processing of customer orders with the help of information systems, technologies and management concepts, with special consideration of high item-specific quality and safety requirements of perishable goods in different temperature ranges' (Straube et al. 2016).

'Food loss' is a term for which there are many definitions in the literature, especially when distinguished from the term 'food waste' (Parfitt et al. 2010; Gustavsson et al. 2011; Kowalska 2017; Garske et al. 2020). This paper follows the understanding of the High-Level Panel of Experts (HLPE) on Food Security and Nutrition of the European Union, which defines food loss as the loss of mass food that was intended for human consumption at all stages of the food chain before it reaches the end consumer. By contrast, food waste is defined as the loss of mass food intended for human consumption at the end consumer stage (HLPE 2014).

The following hierarchy (highest to lowest) was developed with regard to the ways in which losses can be addressed: avoidance of losses, reuse (e.g., through food banks), recycling (e.g., further processing into animal feed or composting), recovery (e.g., losses are used for energy generation) and disposal, which should be avoided if possible (Papargyropoulou et al. 2014).

Following this understanding, the definition of FLM in logistics was derived as follows:

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Table 4 - Description of the food loss management fields of action (Kleineidam 2020).

Field of Action	Description
Transparency	Increase transparency (exchange data and information) within the organisation and between organisations of a network.
Quality management	Improve early detection of weaknesses.
Packaging management	Improve transport and storage processes as well as distribution to the end customer.
Transport optimisation	Improve route planning and loading and coordination of vehicles.
Warehouse management	Improve use of suitable storage equipment, storage strategies and adapted layout planning.
Network structure	Improve strategic network planning and location management.
Physical characteristics	Process adaptations designed to fit the specific physical requirements of the product.
Shelf-life optimisation	Adapt processes to consider special physical requirements of the products, including temperature, pressure sensitivity and air composition.
Network cooperation	Improve cooperation within networks, including information sharing and efforts to develop long-term business relationships.
Mindfulness	Promote awareness among employees at all levels in the organisation regarding the importance of process efficiency and reducing food losses in everyday life.
Consumer satisfaction	Adapt internal processes with the aim of meeting specific customer requirements.
Regulation	Adapt regulations that affect the food value chain and encourage active players to reduce losses.
Financing opportunities	Financial support measures for active actors in the food value chain that enable them to reduce losses.

Various activities with different objectives can be carried out within these fields of action.

Considering the most important aspects relevant in logistics, these include measures that

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contribute to the overall improvement of quality, shorten the time to consumers and/or aim to optimise costs while considering the reduction in food losses.

The framework conditions are primarily the responsibility of administrative and regulatory authorities, which are not the focus of this study; therefore, these fields of action are not analysed further.

The fields of action of FLM can also be categorised in terms of management level (strategic, tactical, operational) and application level (internal, cross-organisational) (see **Figure 28**).

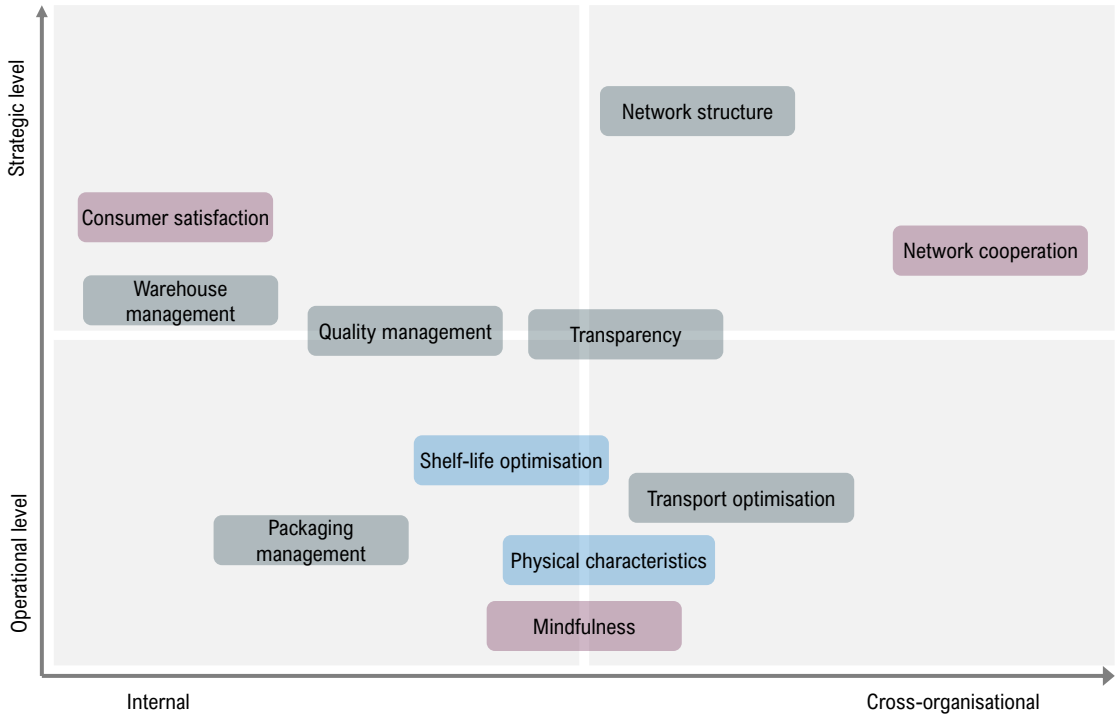

Figure 28 - Classification of the fields of action according to application and company level (Kleineidam 2020).

5.2.2 Structure of food value chains

Today's food value chains are often characterised by complex structures and many actors.

By definition, measures undertaken by the end consumer are not included in this work. While the first group of actors is farmers, not all of their activities are discussed in this study. For example, work in the field that leads to losses cannot be directly assigned to

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FLM in logistics. However, all operational processes of storage and food transport carried out by the farmer belong to it. Thus, this group of actors was considered in FLM in logistics. The process of post-harvesting is also partly carried out by farmers, but it is also carried out by logistics service providers or intermediaries (Astill et al. 2019; Bijman et al. 2006; Dani 2015; Minten et al. 2021).

In international logistics chains in particular, import and export companies are the next actors to handle food. They are usually responsible for the control of cross-border transport, even if they are operationally carried out by logistics service providers. If the consumption or production takes place in the country of origin, the transport carried out by local service providers is the next step in the chain. For products sent for further processing, production follows regardless of the current location. Losses that occur directly through production processes are not the direct focus of FLM in logistics, but processes that are part of production logistics are included. Further transport, whether local or international, follows production to access the consumer markets (Dani 2015; Manners-Bell 2013; Yu and Nagurney 2012).

The food then reaches the end customers via markets or wholesalers (retailers, restaurants and caterers). Authorities and regulatory authorities also influence food value chains through guidelines and regulations that influence FLM (Parfitt et al. 2010; Gustavsson et al. 2011; Dani 2015). Furthermore, especially in developing countries, NGOs are important actors in the food value chain. Depending on the local situation, they take on different tasks and are thus actors who have to carry out FLM. The structure of the food value chain outlined here is shown in **Figure 29**.

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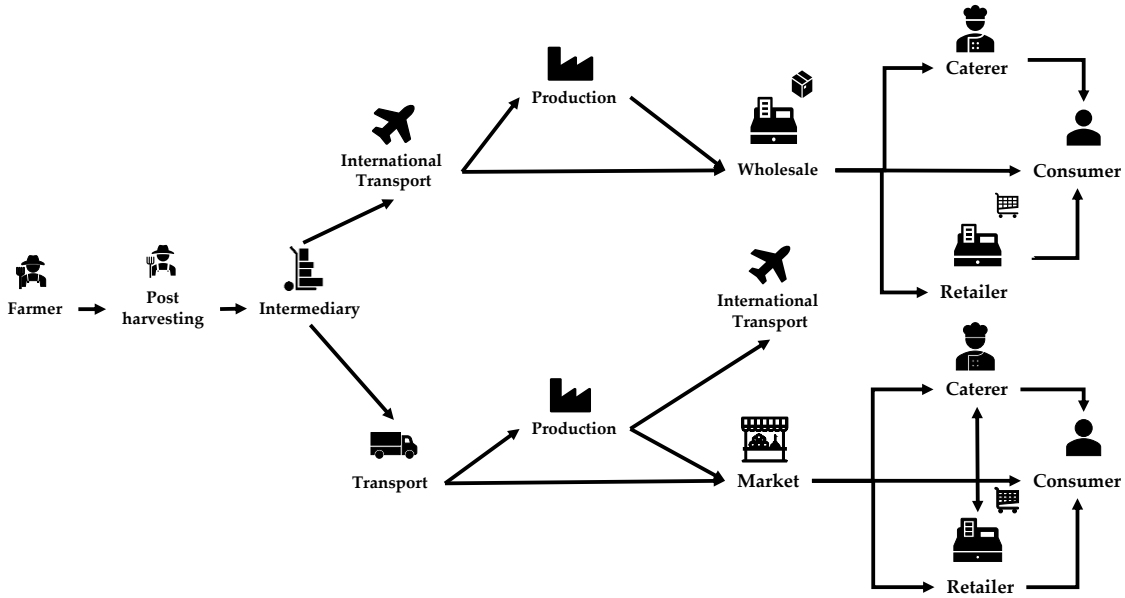

Figure 29 - Functional areas and actors in international food value chains, own representation based on (Parfitt et al. 2010; Gustavsson et al. 2011; Kleineidam 2020).

After introducing the scope of the study, the following section presents how actors in the food value chain can approach FLM.

5.2.3 Readiness assessment in food loss management

The discussion of logistical processes includes the following five dimensions: employees, network, technology, strategy and process (Handfield et al. 2013).

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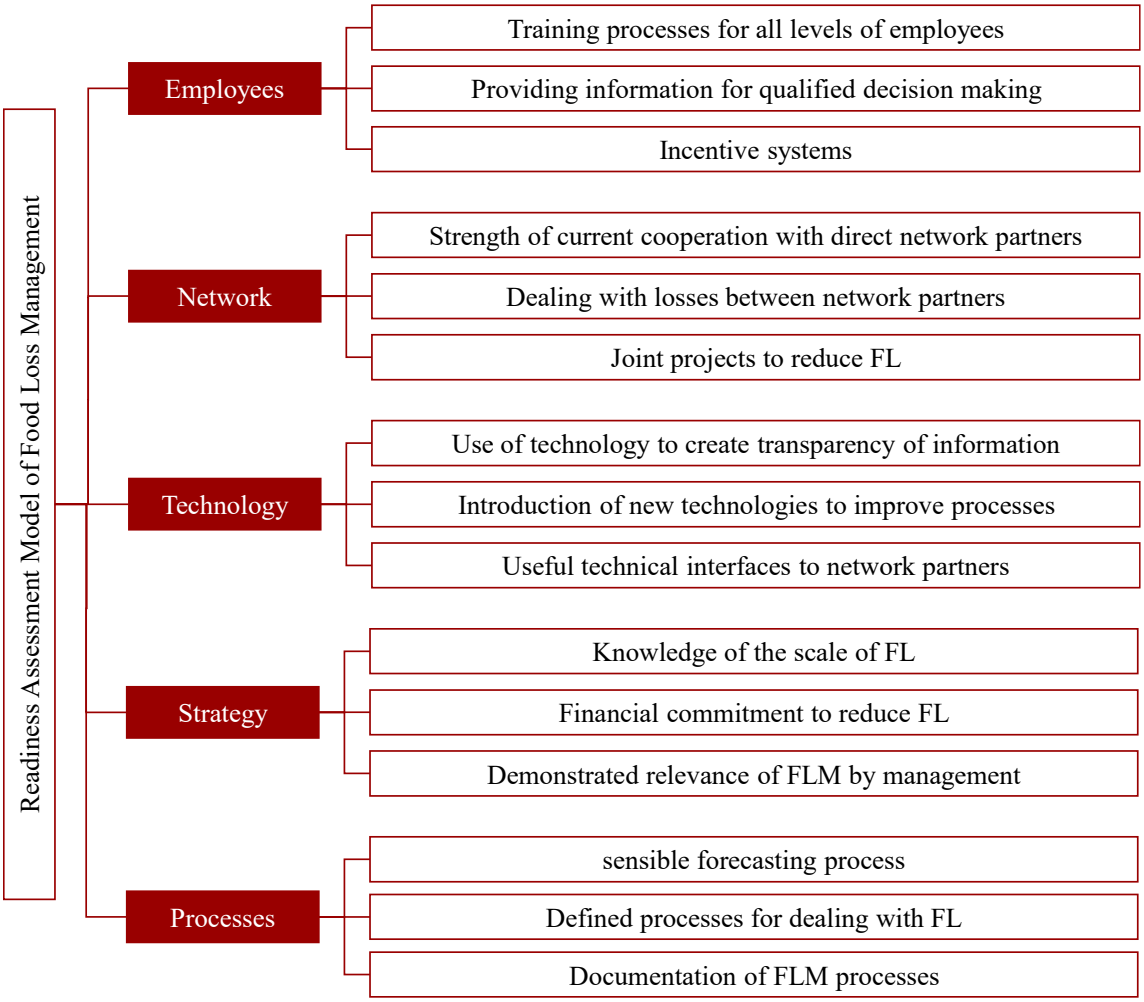

Figure 30 - Readiness assessment model of food loss management in logistics (Kleineidam et al. 2022).

Under this structure, presented in **Figure 30**, the activities of an organisation in the food value chain were examined. At the employee level, the extent to which they were regularly offered training on the reduction in losses was considered, along with the extent to which relevant information on food loss was made available to decision makers, and whether incentive systems were established to encourage employees to contribute ideas for the reduction in food losses.

At the network level, both the strength of cooperation and joint work with network partners on projects to reduce losses were considered. In addition, the extent to which agreements existed with network partners on how losses were dealt with between partners was investigated.

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The technology level considered how organisations introduced new technologies to reduce food losses, the extent to which technology was used to achieve loss transparency, and the extent to which technical interfaces were used to communicate with network partners.

The strategy level examined how much knowledge about losses was available in the organisation's processes, whether and to what extent the organisation made financial commitments to reduce the losses of living resources, and the extent to which management demonstrated the importance of FLM.

The consideration of process levels included the sensitivity of forecasting, the defined processes regarding the handling of food losses and the documentation of FLM processes (Kleineidam et al. 2022).

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5.3 Research design

To identify the readiness levels of actors within the food value chain, a hierarchical clustering method was applied using underlying data drawn from an online survey. Due to the resources available and the given circumstances of the COVID-19 pandemic (which made face-to-face interviews impossible), an online survey using the Unipark platform was chosen for data collection.

The cluster analysis used is an exploratory data analysis technique based on interpretation by a researcher who has insight into the original data (EMC Education Services 2015). The method provides the possibility of finding connections in the data with the help of machine learning, which might be immediately self-evident, and an approach to classifying or grouping observations; thus, it delivers the results necessary for the research questions (EMC Education Services 2015; Baesens 2014). The method was suitable in the present use case because the database contained many different variables for which the identification of commonalities and patterns would be difficult for humans to discern, and which corresponds directly to the strengths of cluster analysis.

In the following section, the data collection and analysis are described in detail.

5.3.1 Data collection

To conduct the cluster analysis, a questionnaire was developed, based on the system described above, to measure the readiness level of FLM in logistics (Kleineidam et al. 2022). Using the above-mentioned dimensions of the model, statements were formulated for which an assessment was made on a seven-point Likert scale as to the extent to which this statement applied to the respective structures. The statements were derived from the above theoretical background and modified by feedback from colleagues (Handfield et al. 2013).

Four statements were developed for the employee level:

- The organisation’s employees are regularly trained in food handling and food loss prevention.

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- The organisation's employees are regularly provided with data on the volume of food losses within the organisation to create transparency.
- Employees with decision-making authority are provided with all necessary information regarding food losses to support decision making.
- Employees are motivated to make suggestions for process improvements that will lead to a reduction in food losses through an incentive system.

Five statements were formulated for the network level:

- We provide our direct network partners with information about our food losses on a regular basis.
- Our direct network partners provide us with information about their food losses on a regular basis.
- If we receive spoiled/inappropriate food products from a supplier, we have agreed upon processes with our suppliers regarding how to deal with these food products.
- If our customers receive spoiled/inappropriate food from us, we have agreed upon processes with our customers regarding how to deal with these food products.
- We work with our network partners on joint projects to reduce losses across organisational boundaries.
- Four statements were developed for the technology level:
- Information technologies are used efficiently to collect data on food losses.
- Information technologies are used efficiently to increase transparency regarding food losses.
- The organisation regularly reviews new technologies for their potential to improve the organisation's FLM.
- Electronic data interfaces have been established with network partners to share food loss data.

Seven statements were created for the strategy level:

- We have an exact overview of losses in our processes and can quantify them.

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- We have an accurate overview of the financial expenses that cause food losses and can quantify them.
- Management leads by making FLM a key strategic issue and supporting continuous improvement.
- The organisation's specific FLM objectives and requirements are properly defined.
- FLM activities are included in the organisation's business plans, and continuous improvement tools are defined.
- For FLM, an organisational structure that demands and utilises the full potential of the workforce is implemented.
- Targeted communication is used to increase food loss awareness and participation and to reinforce the message.

Four statements were formulated for the process level:

- The organisation prepares sales forecasts that regularly reflect reality.
- There is a documented process description that identifies known causes of losses and highlights avoidance strategies.
- The organisation has clear, formalised procedures for collecting food loss data.
- The organisation has specific, formalised procedures for dealing with food losses that occur.

In addition, the following two questions were formulated for the process level, each with the indicated single-choice options:

- Which of the following is the most common form used by the organisation for food losses?
    - No storage strategies in place (scale value 1), last-in, first-out (LIFO) (scale value 3), first-in, first-out (FIFO) (scale value 5), first-expired, first-out (FEFO) (scale value 7).
- What is the organisation's storage strategy for perishable products?
    - Disposal (scale value 1), recovery energy (e.g., via anaerobic digestion) (scale value 3), recycling food loss into animal feed or composting (scale

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value 5), re-using surplus food for human consumption through redistribution networks or food banks (scale value 7)

The questionnaire also included a section asking which fields of action of FLM the respondents had already implemented and which of these fields of action should be addressed in the future (Kleineidam 2020). Furthermore, general questions on the demographics of the respondents were asked.

This online (and anonymous) questionnaire was sent to 171 companies and organisations involved in the food value chain, during the period 15 January to 28 February 2022. Forty responses were suitable for analysis and evaluation, which translated to a response rate of 23.4%. The average response time was 18 min and 25 s. The number of research items was relatively small; therefore, it cannot be assumed that the sample was representative. The aim of the study was not to make binding statements for all organisations, but rather to make initial deductions on the basis of the information found. Further studies can use this information as a starting point.

5.3.2 Data analysis

After the end of the survey period, the data were exported from the Unipark platform. MS Excel was used for the descriptive analysis, and SPSS, as well as R and R Studio, were used for further statistical evaluations and analyses and for the application of the clustering algorithm.

5.3.2.1 Demographics

Figure 31 shows the participation of the different actors in the food value chain.

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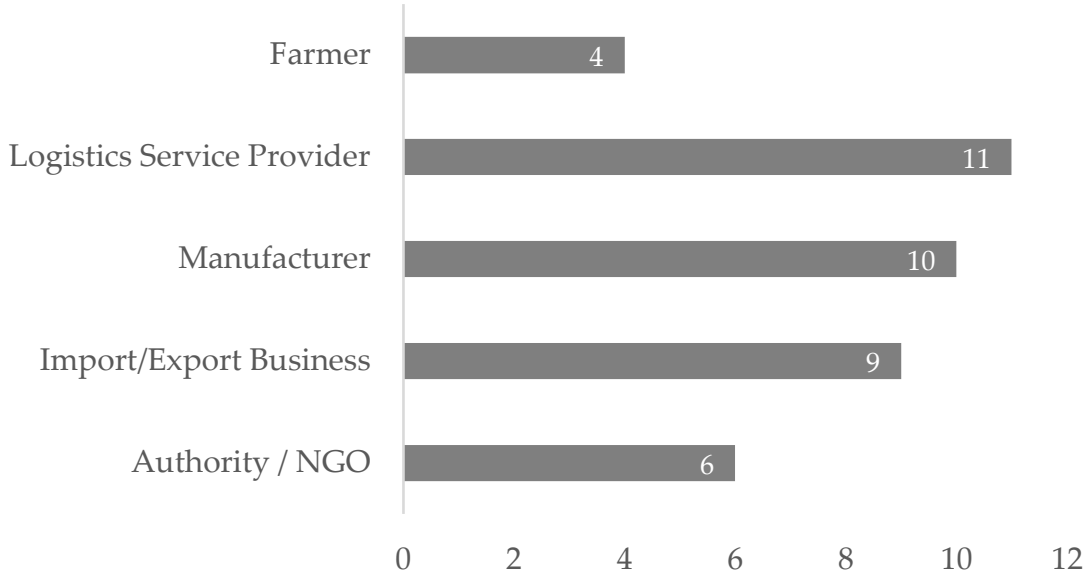

Figure 31 - Value chain actors

The largest group of participants was logistics service providers, with 11 participants, followed by manufacturers with 10 participants, import–export businesses with 9 participants and authorities or NGOs with 6 participants and 4 participants who assigned themselves to the group of farmers. There were no representatives from the group of retailers within the participating organisations. Organisation size was measured by the number of employees and annual revenue. Both indicators are shown in **Figure 32**.

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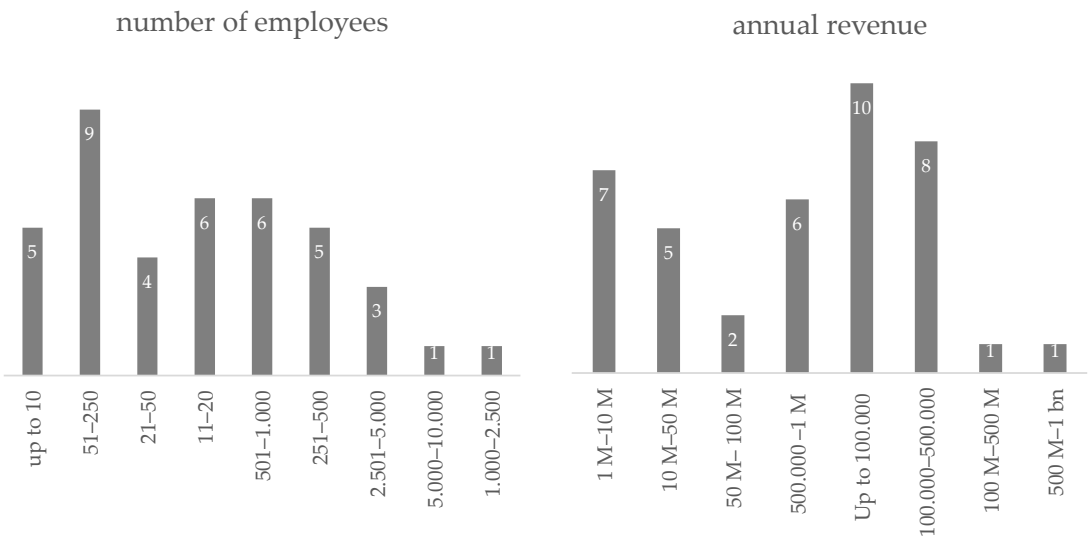

Figure 32 - Organisation size by employees and annual revenue in USD.

According to the European Union's definition, 36 of the participating organisations were small- and medium-sized enterprises [32]. While 5 organisations were micro companies, 10 were small companies and 21 were medium-sized companies.

5.3.2.2 Cluster analysis

Clustering is an unsupervised technique for grouping similar objects, whereby the structure of the data determines the best groups. Unsupervised means that the application of the chosen algorithm is carried out by the system without external influence. Thus, the solution path is not necessarily transparent to the applying scientist. The groups therefore resulted from the chosen algorithm. All observations were evaluated based on their 'distance' from one another and grouped into clusters. In this case, the proximity or distance between the observations was calculated using Euclidean distance. For the distance between the clusters, Ward's D2 method was used (Baesens 2014; How et al. 2020).

To find commonalities in the cases analysed, an index was formed for each of the five dimensions presented and surveyed; these indices were used as variables for clustering. To obtain an overall view of the general engagement with the FLM of an organisation, an overall index was also calculated from five indices, called the FLM index. The decision

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on the number of clusters was made based on the following criteria: The objective of this research was to identify differences in the ways that organisations address FLM and to derive recommendations for action on this basis. The aim was not to produce a 'one size fits all' solution, but rather to respond as specifically as possible to the circumstances identified. Correspondingly, the largest possible number of clusters was found. Based on these preliminary considerations, the minimum number of clusters was set at three. In addition, this procedure also considered the fact that the evaluation was based on a relatively small number of observations. Therefore, it was considered that each cluster contained enough cases to make a meaningful comparison of the cases. When defining clusters, there should be at least three cases in each cluster.

With these prerequisites, clustering was carried out in R Studio. Hierarchical clustering was chosen because it can visually check clusters via a dendrogram. This advantage is also enhanced by the size of the database. The dendrogram is shown in **Figure 33**.

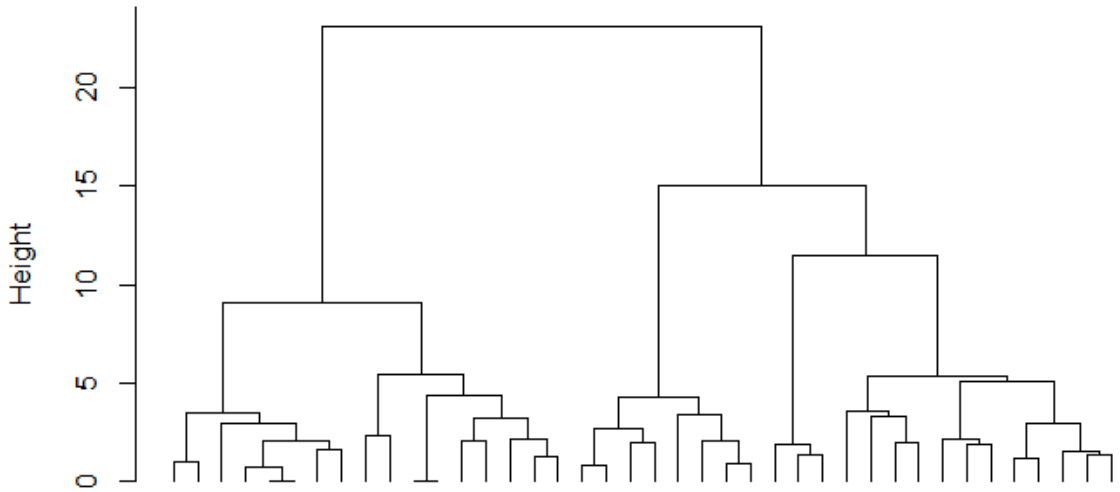

Figure 33 - Dendrogram of all observations

Visual examination suggested that three, four or five clusters would be appropriate. To decide on the number of clusters, an evaluation was made based on 30 indices, all representing different ways of determining the goodness/quality of the clustering results. This function calculated 30 indices to determine the number of clusters. According to the majority rule, this method suggested the best clustering scheme from the different results

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obtained by varying all combinations of number of clusters, distance measures and clustering methods. Of the 30 indices, 12 suggested 5 clusters, 9 suggested 4 clusters, and 2 suggested 6 clusters. Five clusters were chosen because all the clusters represented at least three observations. The distribution of the observations to the clusters is shown in **Figure 34**.

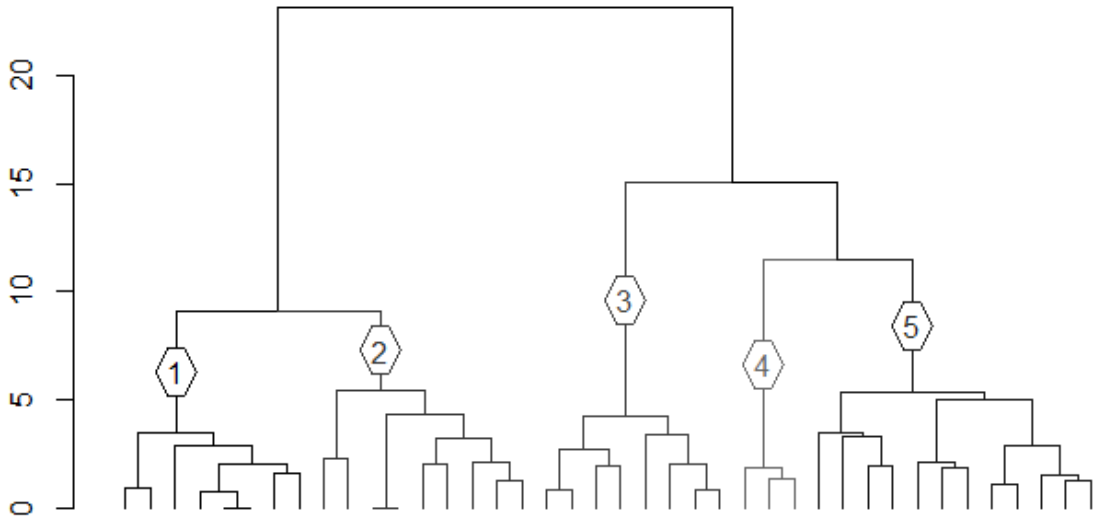

Figure 34 - Dendrogram with the allocation of the selected clusters

The distribution of the number of cases among the clusters can be seen in **Table 5**.

Table 5 - Number of cases per cluster

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
8	9	8	3	12

Based on these values, coherent descriptions were developed for all clusters to describe the characteristics of the organisations within these groups. The results are presented in the following chapter.

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5.4 Results

In this section, the five identified clusters are explained and the characteristics of the cases they contain in terms of their engagement with FLM are outlined. As addressed in the methodology section, Kleineidam et al.'s (2022) proposed model was applied for the analysis.

The five clusters identified can be viewed in order of increased engagement. Importantly, this does not correspond to the numbering resulting from clustering. Cluster 4, described above, lies between clusters 1 and 2 in the order of increasing engagement.

In this way, an expert profile was identified showing extensive engagement with FLM (overall FLM index of 6.1). Likewise, there was advanced engagement with FLM in the advanced profile (FLM index of 4.3). This was followed by two clusters with intermediate levels of engagement that differed greatly in the dimensions of logistics. As a result, the balanced intermediate profile shows a relatively even development of the logistics dimensions (FLM index of 3.1), and the area-specific intermediate profile shows advanced engagement in two dimensions of logistics but little engagement in the other three dimensions (FLM index of 2.7). Finally, the beginner profile describes organisations with little FLM engagement (FLM index of 1.9).

Table 6 summarises the resulting clusters, with their respective values in the dimensions examined.

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Table 6 - Dimension specifications of the identified profiles

Profiles	Strategy	Network	Process	Technology	Employee	FLM index
Beginner	2.3	1.7	2.6	1.3	1.4	1.9
Area-specific intermediate	1.2	1.1	1.3	4.6	5.1	2.7
Balanced intermediate	3.6	4.2	3.2	2.1	2.3	3.1
Advanced	4.4	4.5	3.7	4.1	4.7	4.3
Expert	6.3	6.1	5.8	5.5	6.6	6.1
	3.9	3.9	3.6	3.4	3.9	3.8

Figure 35 provides a visualised overview of the characteristics of all dimensions in the profiles.

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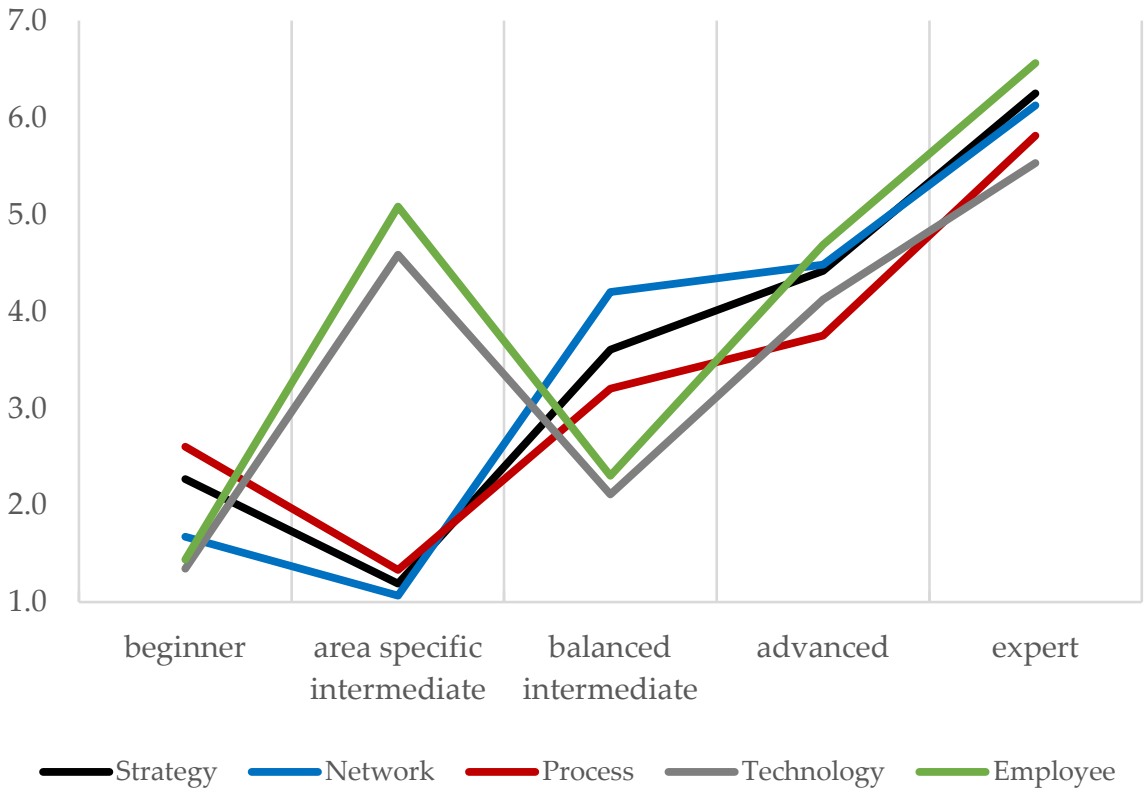

Figure 35 - Characteristics of the logistics dimensions in the comparison of clusters

The individual profiles and their characteristics are explained in more detail in the following section.

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5.4.1 Beginner profile

The beginner profile contained 20% of the participating organisations. These participants had extremely low levels of engagement with FLM in all dimensions. The strongest was the process dimension, with an index value of 2.6, followed by strategy with 2.3, network with 1.7, employees with 1.4 and technology with 1.3.

In this cluster, manufacturers and authorities were equally represented, with three organisations each, while logistics service providers had two organisations. With the exception of one small enterprise, all organisations in this group belonged to the category of medium-sized enterprises. With six organisations, all participants had a large number of customers or buyers (>100). Additionally, one organisation stated that it had 20–50 customers or buyers, while another stated that it had 50–100. However, regarding supplier structures, no clear picture could be drawn because 2 organisations stated that they had fewer than 5 suppliers, 3 organisations stated that they had 20–50, one organisation stated that they had 50–100 and 2 organisations claimed to have >100 suppliers.

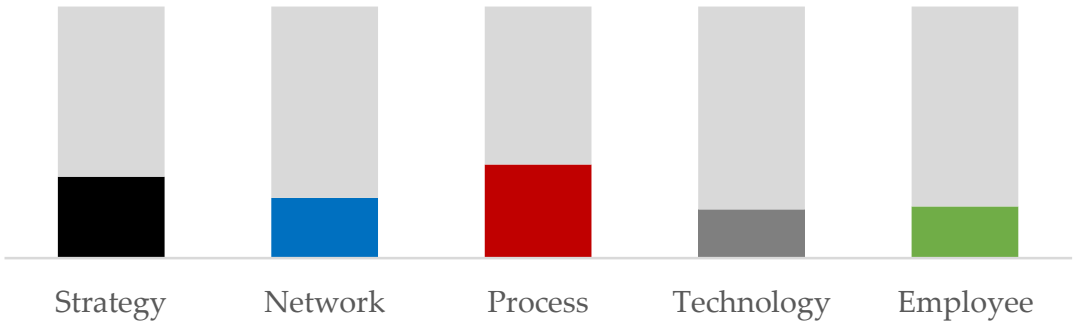

Figure 36 - Level of the five logistics dimensions for the beginner profile

Figure 36 shows the specification of the dimensions for this profile. None of the organisations in the beginner profile stated that they had already consciously implemented measures against food losses, and none planned to implement one or more such measures. Therefore, the relevance of the topic has yet to be incorporated into the structures of these organisations, as is clearly reflected in the indices of the logistics dimensions.

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This was also reflected in the statements these organisations made within the strategy dimension. Not only did the organisations lack a strategy for dealing with food losses, but they also stated that their management attached no particular importance to the issue. As reflected in the other dimensions, no organisation-driven dynamics emerged as a result. The low levels of the technology dimension and the employee dimension were inevitably influenced negatively by this aspect. Overall, the statements made by these organisations show their lack of perceived value in defined and documented processes. The only exception was the fact that the organisations' forecasts delivered good results on average.

As part of their FLM, organisations with this profile indicated that they would be most likely to implement mindfulness measures themselves.

5.4.2 Area-specific intermediate profile

The area-specific intermediate profile was characterised by an extremely uneven distribution of indices. The dimensions of network (1.1), strategy (1.2) and process (1.3) were less pronounced than in the organisations of the beginner profile. The dimensions of technology (4.6) and employees (5.1), which were the least pronounced in the beginner profile, were particularly pronounced in this group of organisations. Notably, 8% of the participating organisations belonged to this cluster.

Only logistics service providers were represented at this level, and they all represented different company sizes (micro, medium-sized and large enterprises). Despite the different company sizes, all these organisations stated that they had few customers or clients (5–10), which could be why they were well positioned in the technology dimension; they encountered less coordination work in terms of their information technology connection to customers.

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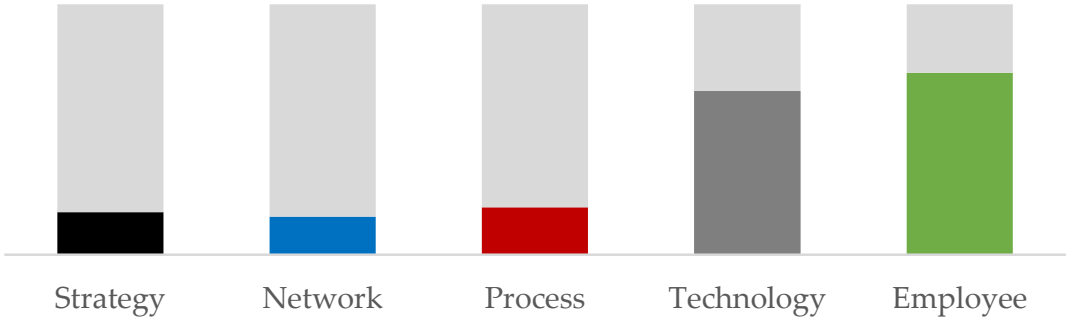

Figure 37 - Level of the five logistics dimensions for the area-specific intermediate profile

Figure 37 shows the specification of the dimensions for this profile. As in the beginner profile, none of these organisations had consciously implemented measures against food losses, and they were not planning to do so in the near future; this indicated that they did not perceive FLM as a relevant factor within their organisation. However, the high degree of the technology and employee dimensions reflected a special orientation of the organisations in this category. While they were particularly oriented towards their employees, the involvement of employees was institutionalised to a high degree through incentive systems, just as there was a focus on ensuring that employees were regularly trained and receiving optimal transparency about the organisations' internal processes. Thus, these organisations, which to a large extent still lacked problem awareness of FLM, were nevertheless well positioned in the employee dimension, showing that good FLM is not an isolated action and can be fostered by other factors. Furthermore, these organisations were characterised by special competences in dealing with technologies. As mentioned previously, the small number of customers or clients in most of these organisations could make a positive contribution. However, these organisations were also relatively well positioned in terms of how new technologies were implemented, showing a reflective approach with a simultaneous desire to use the benefits of new technologies to their own advantage as quickly as possible. Organisations in this cluster could therefore be said to have a high affinity for technologies.

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5.4.3 Balanced intermediate profile

The balanced intermediate profile contained 23% of the participating organisations. The FLM index of this profile was minimally higher than that of the area-specific intermediate profile but showed a different picture in the expression of the dimensions. The network dimension was the most pronounced in this group, with an index value of 4.2, followed by strategy with 3.6, processes with 3.2, employees with 2.3 and technology with 2.1.

Almost half of this group was represented by logistics service providers (four organisations). The rest were distributed as follows: two manufacturers and one farmer, one import/export company; and one representative of an NGO each. Five participants described themselves as medium-sized enterprises, with the remainder claiming to be micro and small enterprises. The suppliers showed clustering, with 4 participants indicating 5–10 suppliers, 1 participant indicating 0–5 suppliers, 2 participants indicating 20–50 suppliers and 2 participants indicating >100 suppliers. A similar accumulation was seen with customers, with 4 participants claiming to have >100 customers, 2 participants each claiming to have 0–5 and 20–50 customers and 1 participant claiming to have 5–10 customers.

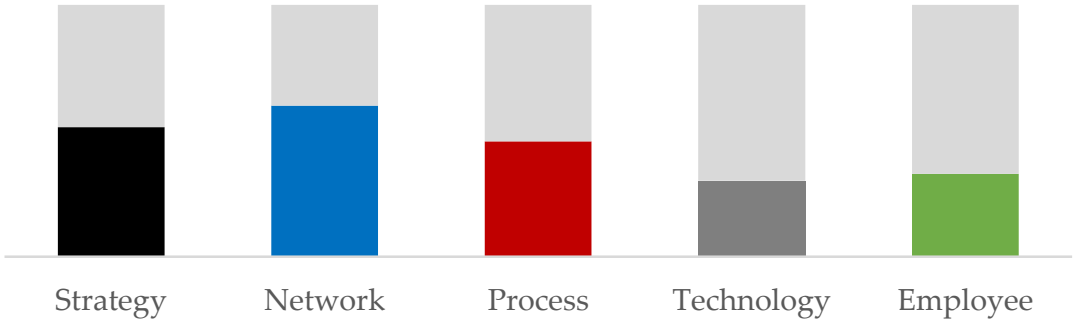

Figure 38 - Level of the five logistics dimensions for the balanced intermediate profile

Figure 38 shows the specification of the dimensions for this profile. The actors in this group had limited similarities to the key figures considered here. However, overall, the organisations with this profile tended to have large networks that they managed well, given their good performance in the network dimension and their FLM. These

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organisations could therefore create and coordinate external processes that function well. Conversely, with internal processes, these organisations had low competence in focusing on their employees, dealing with new technologies, recognising the added value of new technologies and using them for their own benefit.

5.4.4 Advanced profile

The advanced profile contained the largest share of participating organisations, at 30%. With an FLM index of 4.3, the overall level was above average. The employee dimension was the most pronounced (4.7), followed by network (4.5), strategy (4.4), technology (4.1) and processes (3.7).

Of the 12 participants in this cluster, 5 were import–export companies, 3 were manufacturers, 2 were farmers and one each was a logistics service provider and an NGO. Five participants also described themselves as medium-sized enterprises, three were large enterprises, and two each were small enterprises and micro enterprises. The spread was heterogeneous for suppliers and customers. Among the suppliers, the participants were evenly distributed across the entire range, from 0–5 with one mention and 5–10, 10–20, 50–100 and >100 each with 2 mentions. The 20–50 group had 3 mentions. Regarding customers, 4 participants stated that they had <5 or >100 customers, 2 participants stated that they had 20–50 customers and 1 participant each stated that they had 5–10 and 10–20 customers.

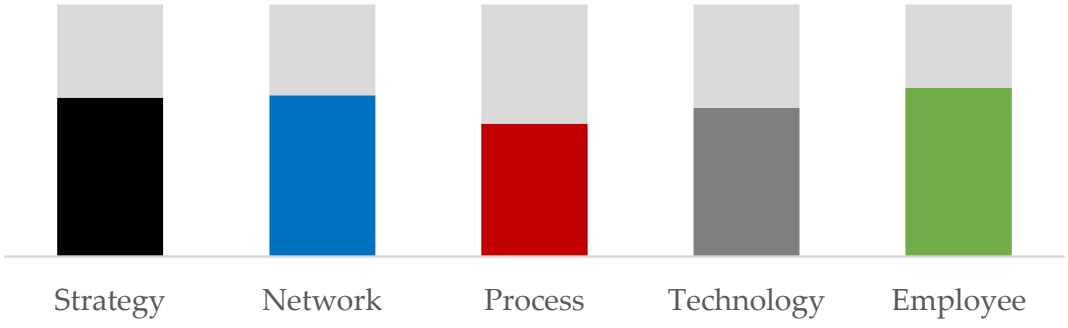

Figure 39 - Level of the five logistics dimensions for the advanced profile

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Figure 39 shows the specification of the dimensions for this profile. As in the case of the balanced intermediate profile, the key figures were heterogeneously distributed. The highly different characteristics of the number of suppliers and customers here, coupled with the above-average characteristics of the network dimension, showed that the organisations could position themselves successfully in this area regarding FLM, regardless of the number of network partners. Additionally, the weakest dimension (process) was the only one below average for this profile group. These organisations were thus characterised by a clear weakness in the alignment of their own processes with FLM, although they generally showed an understanding of how to consider FLM. In this context, it is notable that the organisations within the process consideration predominantly lacked a utilisation strategy for surpluses and simply disposed of them. The majority of these organisations also lacked a storage strategy, which was an obvious weakness within the processes, considering that the shelf life of foodstuffs fundamentally influences losses.

5.4.5 Expert profile

Of the participants, 20% fell into the expert profile, and with an FLM index of 6.1, these organisations were advanced in their engagement with FLM. The most advanced was the employee dimension (6.6), followed by strategy (6.3), network (6.1), process (5.8), and technology (5.5).

This cluster had two representatives each from manufacturers, import–export and logistics service providers, and one representative each came from farmers and authorities. Five enterprises described themselves as small enterprises, and three described themselves as medium-sized enterprises. While 3 participants each stated that they had 10–20 and >100 suppliers, 1 each stated that they had 0–5 and 20–50 suppliers. Half (4) said they had >100 customers, 2 said they had <5 customers and one each said they had 10–20 and 20–50 customers.

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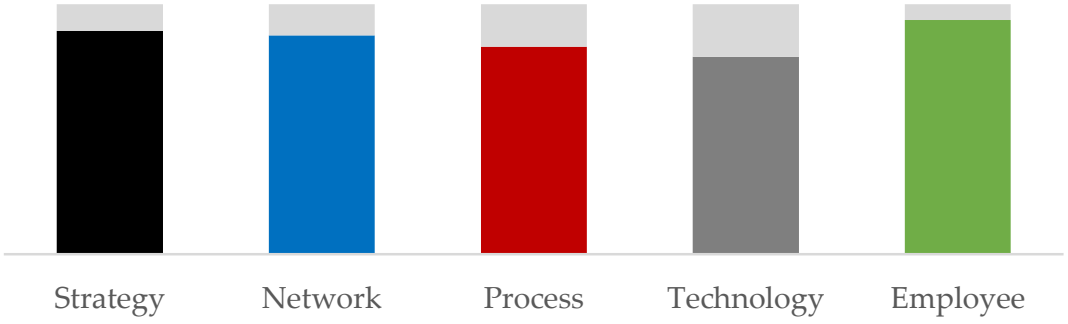

Figure 40 - Level of the five logistics dimensions for the expert profile

Figure 40 shows the specification of the dimensions for this profile. Organisations that displayed this profile showed broad integration of FLM in their structures. They were better in all dimensions than other organisations, especially activities in the dimensions of people and strategy. All organisations with this profile offer their employees extensive training opportunities to strengthen their sensitivity in handling food and to recognise the causes of loss. Similarly, these organisations claimed to have a clear overview of the causes of loss within their own processes. It can be assumed that this supported the good performance of these organisations in the entire FLM.

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5.5 Implications

The profiles presented here reflect groups of organisations that share certain characteristics and have positioned themselves similarly regarding FLM. Notably, these are not developmental profiles that organisations go through until they have fully integrated FLM and are managing it in the best possible way. For an organisation, the question is not how it can reach another profile, but how it can use this assessment to see how it is currently positioned and how it can improve in terms of FLM by building upon its current status. For this reason, the individual clusters will be discussed below, and recommendations for action will be derived based on the characteristics identified and the fields of action surveyed. The recommended activities were derived from the fields of action presented in Section 2.1 and Figure 1, according to Kleineidam (2020).

5.5.1 Beginner profile

Organisations with this profile, as described above, indicated that they would be most likely to implement measures in the area of mindfulness. Given the characteristics of the employee dimension, these efforts would be goal oriented. If employees were trained in the requirements of specific products and needed actions, this weak point in their processes would be addressed. However, being mindful of food products should not be limited to operational actions in handling them. An organisation's management must also be trained accordingly so that all aspects of the conscious reduction in food losses can be considered. Creating awareness of the problem and knowledge of the consequences of one's own actions in daily tasks is essential. Based on the organisations' answers, it can be assumed that especially in the organisational structures responsible for logistics, there was no awareness of the connection between individual decisions and the reasons for losses in one's own structures. Although there was a general awareness of food loss as a global problem, this understanding did not consider one's own organisation or actions regarding the problem.

Furthermore, the analysis of the organisations with this profile showed that besides the lack of awareness of food losses in relation to their own processes, these organisations also lacked an overview, making it impossible to identify the causes of the losses and to

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develop suitable measures that fit the identified weak points. The creation of transparency and the implementation of measures in this field of action are therefore the second elementary topic that organisations with this profile should address. **Figure 41** shows the fields of action relevant to this profile.

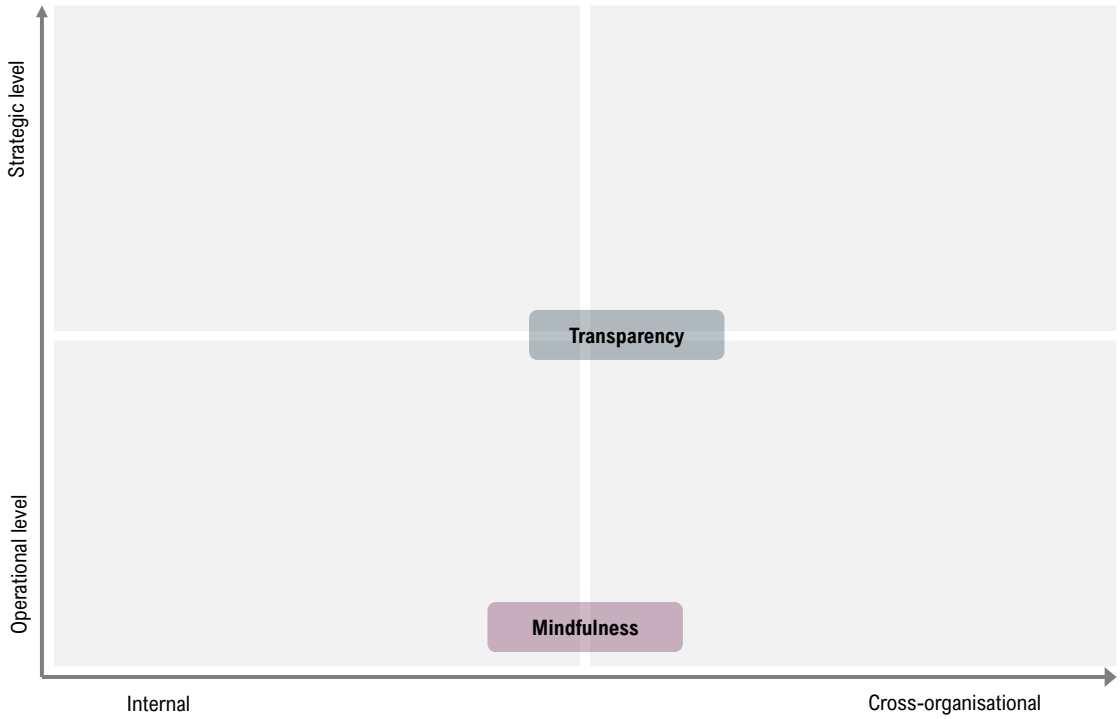

Figure 41 - Suggested fields of action for the beginner profile

Analysis of the technology dimension also showed that these organisations have great potential to move forward using digital solutions. Given the need to lay the foundation for successful work against food loss, these organisations should monitor the current development of digital technologies and develop a mechanism to evaluate them in terms of their usefulness in their own structures. In this context, it should be emphasised that the technologies used should provide each organisation with a better picture of its own processes. Therefore, the focus is more on the provision of information and not on advanced applications, such as decision support systems or automation systems.

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5.5.2 Area-specific intermediate profile

The wide variation in the indices of organisations with this profile suggests that although there was a basic understanding of the problem within the organisation, there was no structured strategy on how to deal with the problem. The general orientation of the organisation in dealing with its employees also had positive effects on FLM. Here, however, just as in the technology dimension, there was rather a positive 'bandwagon effect' due to general competences. The organisations' statements clearly show that they have not yet focused on the structuring of processes. These organisations have significant potential here. Thus, the field of action in quality management should be emphasised by organisations of this profile. The introduction of measures that monitor the quality of the logistical processes will result in existing general knowledge about the necessity of FLM being integrated into the operational processes.

The organisations surveyed here all stated that they had good to very good digital connections to their network partners. At the same time, when asked about their cooperation with network partners, the organisations rated the relationships as underdeveloped or the exchanges with partners as quite low. This contradiction shows great potential. In these cases, the technological conditions exist to work on cross-organisational measures (i.e., the field of action network cooperation). The organisations in this profile, being logistics service providers, underline this potential. Due to their position in the network, they usually have many network partners and can thus exert a great positive influence on the losses in the network caused by a lack of agreement between the network partners by initiating cross-organisational measures. **Figure 42** shows the fields of action relevant to this profile.

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Figure 42 - Suggested fields of action for the area-specific intermediate profile

5.5.3 Balanced intermediate profile

The organisations with this profile were, as previously presented, on a higher level in the dimension's strategy and network than in the other three dimensions. However, a more detailed view of the answers found that they had a poor overview of the losses occurring in their organisations and could not quantify them. Similarly, the answers in the dimension of employees showed a lack of provision of relevant information to employees, and those in the dimension of technology showed a lack of use of appropriate technologies to create transparency. Combined with these answers, it can be concluded that these organisations should focus on the field of transparency. As already deduced from the beginner profile, transparency is a prerequisite for structured engagement with FLM. The positioning of organisations with this profile to date reflects that certain successes can be achieved, even without this basis, but this could also be why these organisations showed greater deficits in dealing with FLM in certain sub-areas. In combination with the low use of appropriate technologies, these organisations should implement measures that lead to better information provision.

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The organisations themselves stated that they would focus on the field of transport optimisation for future activities in the area of FLM. This focus makes sense insofar as organisations are already at a solid level in the dimension of processes and want to build on a foundation there. The fact that all the organisations surveyed mentioned this field of action precisely within the framework of operational processes suggests that the entry barriers to this type of measure are particularly low. Consequently, this can also be seen as a recommendation for organisations with this profile. **Figure 43** shows the fields of action relevant to this profile.

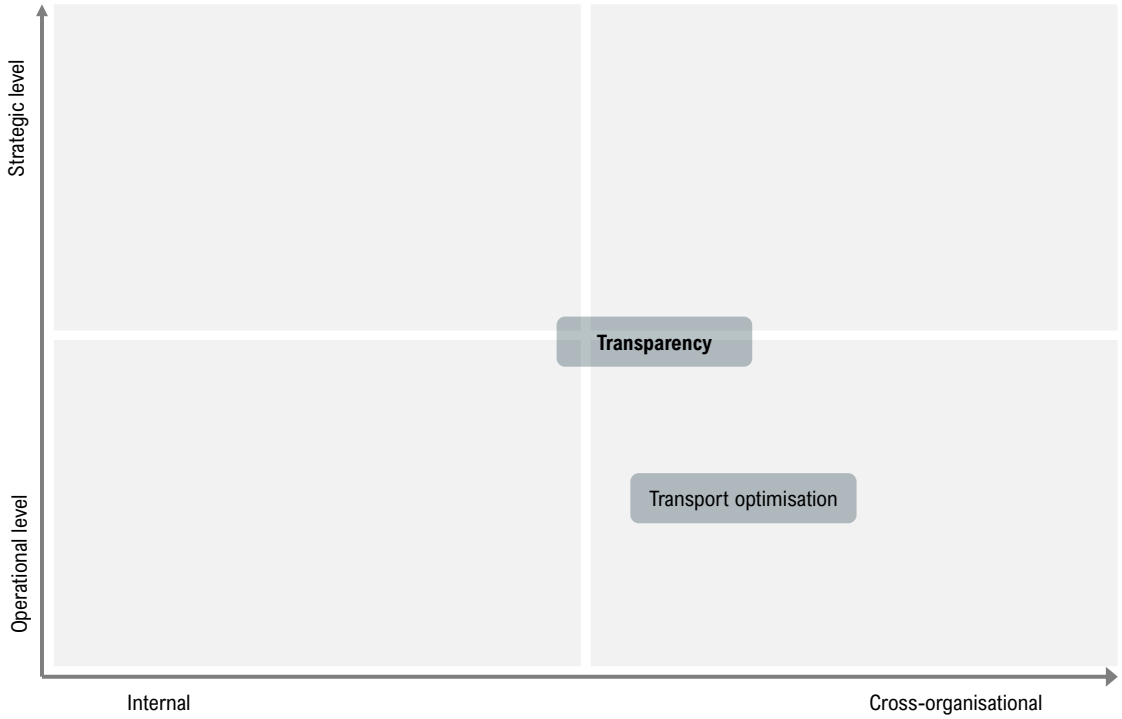

Figure 43 - Suggested fields of action for the balanced intermediate profile

5.5.4 Advanced profile

The organisations with this profile had a relatively balanced level across all dimensions. However, as described above, the process dimension was the least pronounced. Given that these organisations fulfil the previously mentioned basics (namely transparency and mindfulness) at a good to very good level, they have the potential to address further measures. **Figure 44** shows the fields of action relevant to this profile.

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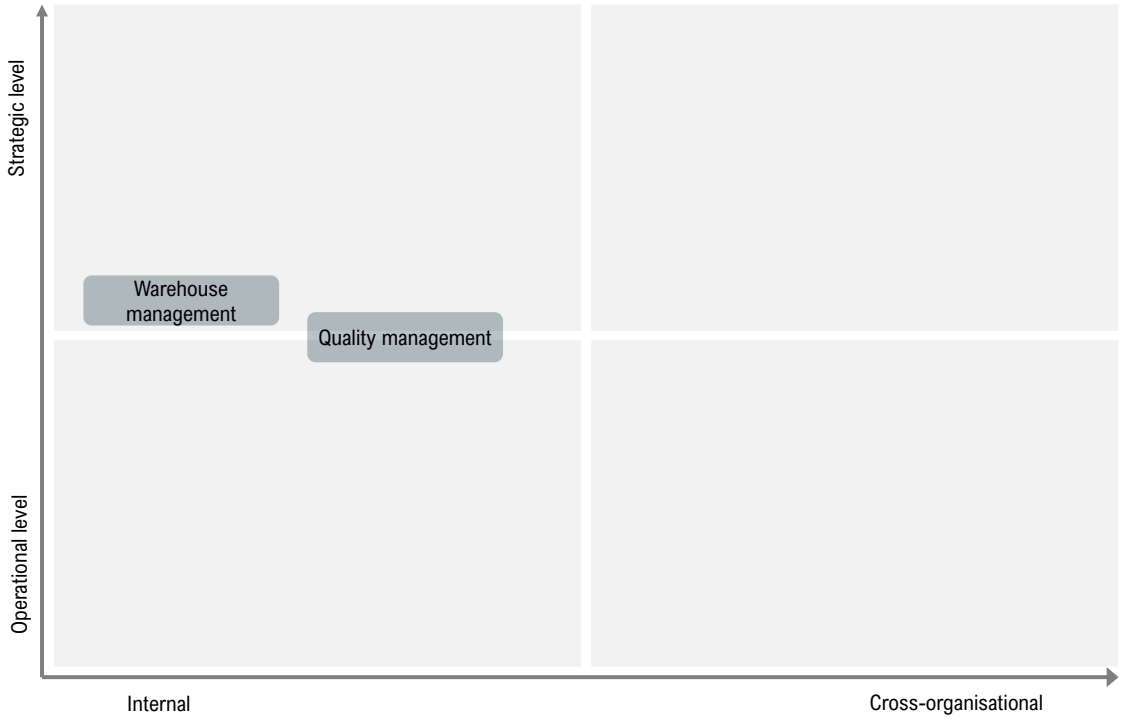

Figure 44 - Suggested fields of action for the advanced profile

In doing so, they should focus primarily on processes that are not as well developed. The majority (86%) of the organisations surveyed stated that they were currently planning measures in the field of warehouse management or wanted to implement them in the future. This finding aligns with the fact that these organisations consistently stated that they had either not implemented any storage strategies at all or were working with a LIFO principle. Due to the limited lifespan of food, this storage strategy tends to be the cause of losses that could be removed relatively easily through adapted control of the process.

Based on further statements by these organisations, it can be concluded that a focus on improving quality management in logistical processes can make a positive contribution. These organisations, being well positioned technologically, should use this competence in the field of quality management. Here, the existing ability of the organisation to create transparency can also be used. An exemplary measure in this field could be process management to improve the quality of processes.

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5.5.5 Expert profile

The organisations with this profile already had extensive experience with consciously integrating FLM into their own processes and in cooperation with network partners. However, the potential to further reduce food losses exists. Due to their previous experience with FLM measures, generalised recommendations for action are more difficult to derive than for organisations with the profiles already presented. Nonetheless, the fields of action least focussed on by these organisations include the adaptation of the network structure and the adaptation of the processes to specific product characteristics. **Figure 45** shows the fields of action relevant to this profile.

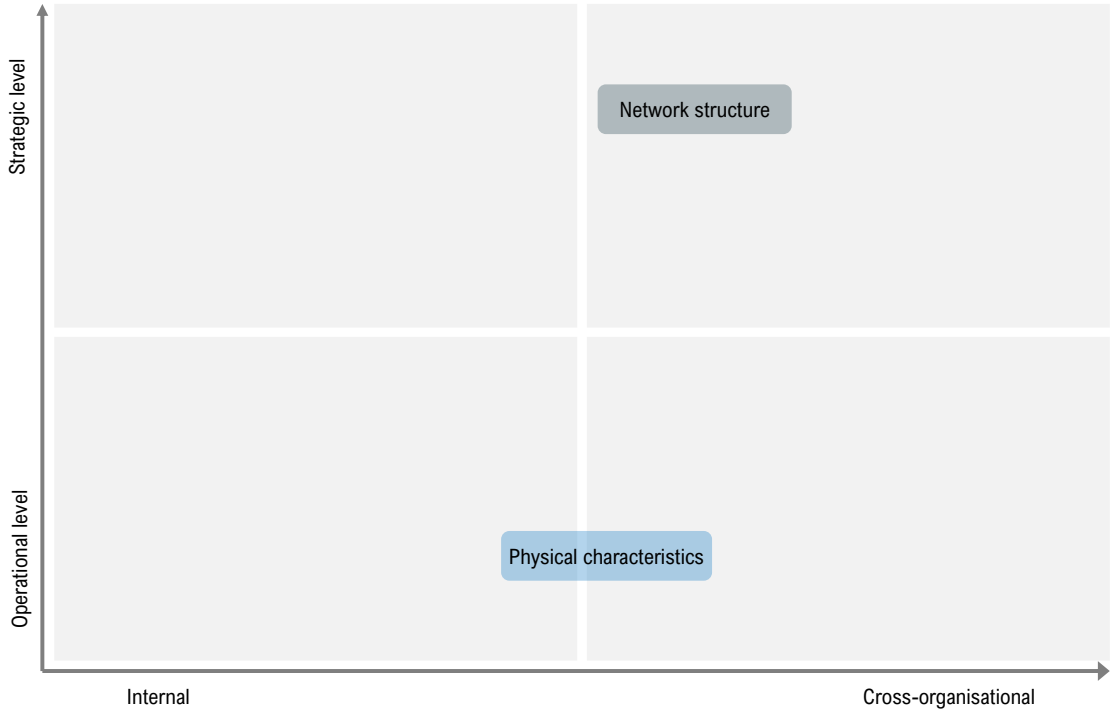

Figure 45 - Suggested fields of action for the expert profile

The adaptation of the network structure cannot be implemented in the short term, moving it down the list of fields of action to address. To avoid food losses by changing the network structure, it is necessary to either improve the connections between the nodes or bring them closer together. However, organisations that have already progressed this far should consider these measures.

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The high performance of these organisations in the field of technology should encourage them to consider product characteristics. In this context, this means process optimisation with the aim of matching the physical environment of the food to its requirements. This involves factoring in temperature, air composition, humidity and pressure sensitivity. Adapting the physical environment to product properties in an optimal way extends the shelf life of food.

5.5.6 Summary

The purpose of this study was to answer the following research questions:

> **RQ1:** How can organisations of food value chains be differentiated in terms of their readiness levels with regard to the implementation of FLM in logistics?
>
> **RQ2:** How can this distinction be used to derive recommendations for action for the future implementation of FLM in logistics?

By deriving profiles from the cluster analysis, RQ1 can be answered: five different organisation profiles were identified, distinguishing between beginner, area-specific intermediate, balanced intermediate, advanced and expert.

To answer RQ2, recommendations for action were derived based on the characteristics of the identified profiles. For this purpose, fields of FLM action were drawn from the literature and compared with the prerequisites of the organisations in the respective profiles. In summary, these organisations showed little engagement with FLM to date and should begin by creating transparency and mindfulness. The further the organisations are in their engagement with FLM, the more complex fields of action should be addressed.

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5.6 Conclusions

The derived profiles of organisations allowed for an initial conclusion regarding an organisation's previous involvement with FLM. However, to obtain a holistic picture of the framework conditions within a company, further considerations are needed. The fields of action proposed here are a rough guide; no concrete measures with defined activities are recommended. These must be developed appropriately for each specific application. The present study thus has limited implications for science and practice.

5.6.1 Scientific implications

To expand the scientific knowledge base, this study provides a systematisation of organisations' levels of engagement with FLM from a supply chain management perspective. Such an approach does not yet exist in the scientific literature. Other researchers can use this framework as a starting point to launch specific research projects, and on this basis further research projects can be developed based on a concrete company situation.

5.6.2 Practical implications

For practical applications, two use cases in particular can be considered. Organisations can determine their own status on the basis of the questions and profiles listed here and derive further procedures for FLM for themselves on the basis of the fields of application. Furthermore, the framework presented here can be applied by aid organisations or governmental organisations that want to support activities in the field of FLM in developing countries. Based on the recommendations contained in this study, projects could be developed in project development workshops.

5.6.3 Limitations

The respondents were all based in East African countries, so in principle, the results could have been influenced by the framework conditions applied in these countries. To rule this out, it would be beneficial to consider the question by including actors from industrialised countries, for example. Nevertheless, this work provides a first insight into and orientation for actors who want to address FLM in the future. Furthermore, the total

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number of participants was relatively small. This limitation makes further in-depth analyses and statements derived from them more difficult, such as on the specificities of certain actors in the food value chain. For this reason, these types of further analyses were not included in this study. Therefore, an extension of the study with a different population would be prudent. Other limitations include the application of clustering and the fact that the model was strongly influenced by the selection of the variables used. The choice of other variables could have led to different results. However, through the variables derived from the literature, a logical basis for these results was established. As mentioned in the methodology section, this method depends on the assessment of the involved researchers. Thus, there is a methodological bias of the scientist occurring. By applying and documenting clear criteria for the selection of the clusters, this influence was kept as low as possible.

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5.7 Final remarks

The goal of this study was to identify differences between organisations' engagement with FLM and recommend actions for their respective circumstances.

Five clusters were derived representing different profiles, showing how actors in the food value chain have addressed FLM in the past. The derived profiles do not represent stages of development but rather characteristics of organisations that have dealt with FLM in a certain way in the past.

Conclusions: For the five organisational profiles, recommendations for action were given for further engagement with FLM. As the level of engagement with FLM increases, organisations should tackle increasingly complex measures to reduce food losses. At the same time, a shift in measures was derived from the tactical to the strategic planning level.

This study is a first step towards a science-based evaluation of FLM activities of actors in food logistics networks and subsequent recommendations for action. This can therefore only be a first step, as an evaluation is needed to see to what extent the recommendations for action derived from this study lead to the implementation of the desired successes. This is where further research should be conducted to provide a broad scientific basis for the application of successful measures against food losses in food logistics networks.

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6 Development of the logistic management model for food loss reduction in East African food value networks

As stated in the introduction of this dissertation, the aim of this dissertation is to develop a process model that supports actors in East African food value networks to develop logistics measures for their processes that help to reduce food losses in value networks in East Africa. The countries Ethiopia, Rwanda, Tanzania, and Kenya are the focus of this study. Basically, from the point of view of application-oriented science, a concept would be helpful which can provide indications on reduction potentials of individual measures. However, the preparatory work for this dissertation has shown that most of the actors in the study region are not able to quantify the losses in processes and also do not know how to deal systematically with food loss reduction management. Consequently, the foundation for the concept outlined above does not exist in East Africa. Rather, from the perspective of application-oriented science, what is needed is support for local actors in East Africa in how they can approach the issue in principle. So, a quantitative model does not serve the purpose in the sense of application-oriented science. Therefore, the goal of this dissertation is to develop a process model that provides organizations with a structured and repeatable process on how to develop systematic logistical measures to reduce losses in value networks in East Africa. For a successful reduction of losses, the measures must fit the circumstances in the organization. For this reason, the approach must include an examination of the organization's current situation as well as its previous exposure to food loss reduction management. The procedure must also include a discussion of the process steps in which losses are present and how they are to be quantified. Finally, the approach should include a guideline on how to select logistical measures for food loss reduction in East African food value networks.

The addressees of the model are primarily companies and organizations that play an active role in food value networks in East Africa. However, the procedure model can also be implemented by regulatory levels in cooperation with the active actors. In principle, it can be applied by all actors who can help shape processes in East African food value networks. Since the model was built based on data from East Africa, the model does not claim to be suitable for food value networks in other regions of the world. The model was developed for the context of East Africa. This means that all components that emerged

from the preliminary work of the articles were conducted with a focus on value networks in East Africa. The companies that participated in the interviews and case studies conducted as part of this dissertation all operate in East Africa. Specifically, organizations with operations in the countries of Ethiopia, Rwanda, Tanzania, and Kenya participated. The majority of these are local small and medium-sized enterprises. Organizations that take active roles in local food value networks but do not pursue entrepreneurial profit have also participated. These include, for example, non-governmental organizations that act as logistics service providers in the region to supply food to the local population. It should also be noted that the derivation of the readiness assessment, which is a core component of the originality of this dissertation, was developed based on local conditions in East Africa. Thus, no claim is made that it applies to other regions.

The study focused on foods in the plant products category, more specifically fruits and vegetables as well as cereals. Animal products were not explicitly considered. Due to the availability of participating companies and organizations, no further restriction to more specific product groups could be made. On the one hand, it should be noted that most actors do not exclusively handle one product. On the other hand, the amount of available actors would not have been sufficient for the scientific claim of this dissertation for single products to use the found facts for more than a single case analysis. However, to illustrate the contents, individual products for which more detailed information is available will be singled out in the following.

The goal of this dissertation is to develop a management model that provides a structured process for managing food loss reduction. Since this dissertation is written in the context of the application-oriented scientific discipline of logistics, it is necessary to formulate a research objective that considers the countervailing reality in East Africa, the area under investigation in this dissertation, and develops a solution that fits it. The introductory analysis concludes that local companies in the study area have largely been unable to quantify their losses or track them in a meaningful way. There is largely no awareness of the relevance of loss reduction, as this has not been seen as relevant to main business functions to date. However, as also outlined in the introduction of this dissertation, the consistent reduction of food losses has economic potential for individual organizations on the one hand and contributes to their commitment in terms of social and environmental responsibility on the other. Thus, an adequate research objective is one that supports

organizations in integrating food loss reduction management into their own processes as well as creating transparency through this structured process that does not exist today.

In order to achieve the goal of this dissertation, the foundations were laid in the previous parts of the dissertation. In the 3rd chapter, the fields of action were identified, which are applied in the context of logistics in order to reduce food losses. Based on the statements of local experts, the 4th chapter identified the most important organizational areas in which organizations can lay the foundation for successful food loss reduction management by positioning themselves in certain ways. Based on these findings, a readiness assessment to evaluate engagement with food loss reduction management was developed to help organizations determine their own status in addressing this issue to date. chapter 5 of this dissertation then identified engagement types of organizations with food loss reduction management through the application of these readiness assessment tools. Based on the statements of the companies involved in the study, the identified fields of action from chapter 3 were then assigned to these organizational profiles. In order to achieve the goal of the dissertation, a management model is presented in the following, which on the one hand connects the previous results of this work, integrates them further into the context of the field of investigation and combines the newly gained knowledge through the on-site investigations and the combination of the facts.

The discussion and integration of food loss reduction management is not yet widespread in most economically active organizations in the target region of East Africa (compare chapter 2). In order to promote food loss reduction management in an organization, it is therefore necessary for the organization to examine its own current state and, based on this, find solutions for the individual case. As described in the introduction of this dissertation, this investigation is based on Ulrich's integrated business ethics. This states, in summary, that companies are not only committed to their corporate purpose and thus to making a profit but must also do their part to ensure the common good of society. In the context of food losses, this means the responsibility to take all necessary measures to ensure that the food that passes through the company's value network is also delivered to its intended use, i.e., human consumption. This means that responsibility extends not only to the company's own processes, but also to the upstream and downstream stages of the value network, right through to the end consumer. Companies in food value networks are therefore obligated to use all the means at their disposal to ensure that the word creation

network is as loss-free as possible. Depending on the company's position of power within the network, the company's room for manoeuvre is shaped and thus varies in size. Companies must take this into account in their actions. According to this logic, however, companies with a low power position are also required to make the greatest possible efforts to reduce losses in the network.

From the results presented up to this point, it can be concluded that many companies see the relevance of food loss reduction management in the future but have not yet implemented a strategy or a process on how this is to be implemented in their own organization. They lack a clear picture of their own state in terms of how they have addressed food loss reduction management previously. So, the first step is for organizations to analyse their own status in addressing food loss. This is necessary because, as mentioned several times in the previous sections of the dissertation, the state of the organization is an important prerequisite for the selection of appropriate food loss reduction measures.

On this basis, the organization can be assigned a profile of the engagement, which simplifies the selection of appropriate reduction measures. Furthermore, it was determined that many companies that already take measures against food losses neither perform a root cause analysis in advance nor have a clear picture of the amount of losses. In many cases, action is taken either because of an accident or based on the participants' intuition. Or action is taken based on the participants' intuition. Both can lead to success, but always carry the risk that relevant causes of losses are not included in the considerations and thus large reduction potentials are overlooked. The second step of a structured approach must therefore be a food loss status analysis of the existing structures. This must include both quantification of current losses and a detailed analysis of loss sources within the processes. Once these two steps have been completed, the selection of suitable measures can be carried out on this basis. The prior assignment to organizational profiles makes it possible to develop individual measures in a targeted manner within the framework of the appropriate fields of action. In addition, organizations must place particular emphasis on creating transparency. Depending on the activity level of the implementing organization, different priorities must be set. This process should not be seen as a one-off activity, but as a recurring improvement process. On the one hand, the sustainable effect of the implemented measures should be emphasized. On the other hand,

the regular application of the readiness assessment and the analysis phase should be used to check the status of the organization and, if necessary, to develop further measures. This logic is described in more detail below.

6.1 Initial screening through the application of the readiness assessment

Based on the investigations conducted in the context of this dissertation, it could be determined that the success of food loss reduction measures is highly dependent on the question of whether the respective measures fit the structure and the circumstances in the respective organization. It could be determined that organizations have implemented technical solutions, for example, which are basically helpful in solving the problem. However, these organizations reported that they did not see any long-term success because, for example, the employees were not willing to apply this solution in the everyday processes. Here, employees lacked awareness of the relevance of food loss reduction management. In other cases, the introduction of a solution did not take into account that the informational prerequisites for a solution were not fully in place and thus it did not contribute to the reduction of losses in the long term. Cases were also observed in which organizations specifically used measures with network partners to reduce losses. In these cases, it was reported that the reduction of losses was hardly effective because the internal processes and the attitude of the employees were not aligned with the food loss reduction management and thus resistance to these measures existed within the organization. These examples show that it is necessary for the organization to know its own status in the previous engagement with food loss reduction management in order to take this into account in the solution development and also to set the respective system boundaries of the efforts for food loss reduction management.

Accordingly, the initial screening of the model developed here consists of the application of the readiness assessment developed as part of this dissertation and the resulting assignment to the identified organizational profiles of engagement with food loss reduction management. This is as described in chapter 4, built from the dimensions of logistics to address logistics trends according to Handfield, Straube and Pfohl (2013) and the identified barriers to action in the study area in East Africa. The readiness assessment is structured in 5 categories in which the applying organization can examine its previous level of engagement with food loss reduction. These five categories are “Strategy”, “Network", “Process”, “Employee” and “Technology”.

At the strategy level, the study examines how much knowledge the organization has about losses that occur within the organization. It also examines the extent to which the organization's leadership has addressed the issue and incorporated this into strategic

considerations, and whether this has already been incorporated into organizational structures. In addition, the status of the organization's internal communication on this issue will be examined.

At the network level, both the strength of collaboration with network partners and joint work with network partners on loss reduction projects are examined. In addition, the extent to which agreements exist with network partners on how to deal with losses between partners is examined. Thus, communication with network partners is also a component of the assessment.

The consideration of process levels included the sensitivity of forecasts for food sales, the degree of standardization of processes in dealing with food losses and the handling of food as well as the documentation of food loss reduction management processes. In addition, the storage strategy for food and the use of occurring food losses are queried.

At the employee level, the study examines the extent to which loss reduction training is regularly provided to employees, the provision of food loss information to employees to create transparency, the extent to which relevant food loss information is made available to employees with decision-making authority, and whether incentive systems have been created to encourage employees to contribute food loss reduction ideas.

At the technological level, it is investigated to what extent the organization monitors current technology developments and reviews them with regard to their potential for reducing food losses. In addition, the extent to which technology is used to create transparency about losses and the extent to which technical interfaces are used for communication with network partners is surveyed.

The content of each of these five categories is assessed by means of statements which are rated on a scale of one to seven as to how applicable they are to the organization under investigation. The questionnaire for this can be found in the appendix to this dissertation (see chapter 10). Based on the scale values, a value is formed for the respective category for each of the five categories by forming the arithmetic mean. In this way, an assessment results for the organization under study, which can be represented by the following variables:

$$x_{o1} \triangleq Scale\ value\ of\ strategy\ category\ of\ investigated\ organization$$

$$x_{o2} \triangleq Scale\ value\ of\ network\ category\ of\ investigated\ organization$$

$$x_{o3} \triangleq Scale\ value\ of\ process\ category\ of\ investigated\ organization$$

$$x_{o4} \triangleq Scale\ value\ of\ employee\ category\ of\ investigated\ organization$$

$$x_{o5} \triangleq Scale\ value\ of\ technology\ category\ of\ investigated\ organization$$

These values provide an initial insight into where the strengths and weaknesses of an organization lie in its previous involvement with food loss reduction management. Since the goal is to derive further actions on this basis, profiles of organizations were derived from the surveys carried out in the context of this dissertation (cf. Chapter 5) by conducting a cluster analysis. Within the scope of this survey, the assignment of fields of action to the organizational profiles was also examined. This is discussed in more detail in section 6.3 Selection of activities). For these profiles, the characteristics of the variables defined above were identified, which can be found in the following **Table 7**.

Table 7 - Scale values of the organizational profiles

	x_{p1}	x_{p2}	x_{p3}	x_{p4}	x_{p5}
beginner	2.3	1.7	2.6	1.4	1.3
area specific intermediate	1.2	1.1.	1.3	5.1	4.6
balanced intermediate	3.6	4.2	3.2	2.3	2.1
advanced	4.4	4.5	3.7	4.7	4.1
expert	6.3	6.1	5.8	6.6	5.5

Whereby it is valid:

$$x_{p1} \triangleq Scale\ value\ of\ strategy\ category\ of\ the\ organization\ profile$$

$$x_{p2} \triangleq Scale\ value\ of\ network\ category\ of\ the\ organization\ profile$$

$$x_{p3} \triangleq Scale\ value\ of\ process\ category\ of\ the\ organization\ profile$$

$$x_{p4} \triangleq Scale\ value\ of\ employee\ category\ of\ the\ organization\ profile$$

$$x_{p5} \triangleq Scale\ value\ of\ technology\ category\ of\ the\ organization\ profile$$

With the help of these values, the organization under investigation can be assigned to one of these profiles. For this purpose, the smallest deviation between the category values of the profiles and the examined organization is determined for each organization profile. The following formulas are used for this purpose:

$$V_{beginner} = \sum_{i=1}^{5} \left| {x_{pi}}^2 - {x_{oi}}^2 \right| \quad (1)$$

$$V_{area\ specific\ intermediate} = \sum_{i=1}^{5} \left| {x_{pi}}^2 - {x_{oi}}^2 \right| \quad (2)$$

$$V_{balanced\ intermediate} = \sum_{i=1}^{5} \left| {x_{pi}}^2 - {x_{oi}}^2 \right| \quad (3)$$

$$V_{advanced} = \sum_{i=1}^{5} \left| {x_{pi}}^2 - {x_{oi}}^2 \right| \quad (4)$$

$$V_{expert} = \sum_{i=1}^{5} \left| {x_{pi}}^2 - {x_{oi}}^2 \right| \quad (5)$$

The organization under investigation is assigned to the profile with the lowest V value.

As already mentioned, the organization should define the system boundaries for the further food loss reduction management depending on its previous involvement with food loss reduction management, i.e., depending on its organizational profile assigned here. The following section discusses the levels of focus on which the respective profiles should focus.

Organizations with Beginner profile are in the early stages of addressing food loss reduction management. These organizations should focus primarily on their internal processes and eliminating internal causes of loss. Nevertheless, these organizations may also enter into collaborations with other organizations regarding food loss management. In this context, support from organizations with greater market power is of particular importance. Such cooperation is in the sense of increasing the overall benefit for the network and thus for the common good. Based on this reasoning, such cooperation could be initiated by both sides. However, it requires a corresponding sense of responsibility on

the part of the organization with the greater market power to accept the expenses associated with the required support. Therefore, these organizations must be at an advanced stage of addressing food loss management. However, for the analysis phase, these organizations should focus on their own organization and set their system boundaries accordingly.

Organizations with profile area specific intermediate do not follow the logical path that an organization should first bring the internal structures to a certain level before focusing on the network level. These organizations have particularly good cooperation and connections to network partners due to their other competencies outside of food loss management. For this reason, they also have a good exchange in the area of food loss reduction management. However, they have not yet addressed the internal causes of losses and have a lack of knowledge and awareness of food loss management in their internal structures. Organizations with this profile therefore need to lay the groundwork within the organizations to profitably use the existing good structures for food loss management in collaboration with network partners. Especially in this case, the established relationships with network partners can be used to benefit from possible knowledge advantages of these partners. Once these organizations have recognized the relevance of food loss management for themselves, they should approach their network partners with advanced food loss management and seek their support. Like the Beginner profile organizations, these organizations should not go beyond the system boundaries of their own organization for the analysis phase.

Organizations with the profiles balanced intermediate and advanced have already established the basic requirements in their internal structures and are expanding their activities towards direct network partners. Organizations with profile balanced intermediate are at the beginning of establishing cooperation with network partners to improve food loss management. They have implemented initial projects with network partners and are working to expand these collaborations. Organizations with profile advanced have very well-established collaborations with network partners but see further potential through further expansion of these collaborations and more joint projects. In addition to their expertise in dealing with food loss, these organizations also have the ability to support network partners at the beginning of their engagement in dealing with

food loss. Following this, organizations with one of these profiles should include their direct network partners in the analysis phase and set the system boundaries accordingly.

Organizations with profile expert have very good internal structures and work very intensively with direct network partners. They also strive to make structural changes within their network to counteract food losses, either by moving production to earlier points in the food value network or by shortening the entire food value network. These organizations should consider the entire network they can see in the analysis phase.

For an implementing organization, this step of the model means that the own structures are critically reflected on the basis of the presented statements. The statements within the assessment are kept at an abstraction level so that the specific requirements of the food types handled in each case are not directly included in the analysis. **Figure 46** depicts the process of this initial screening.

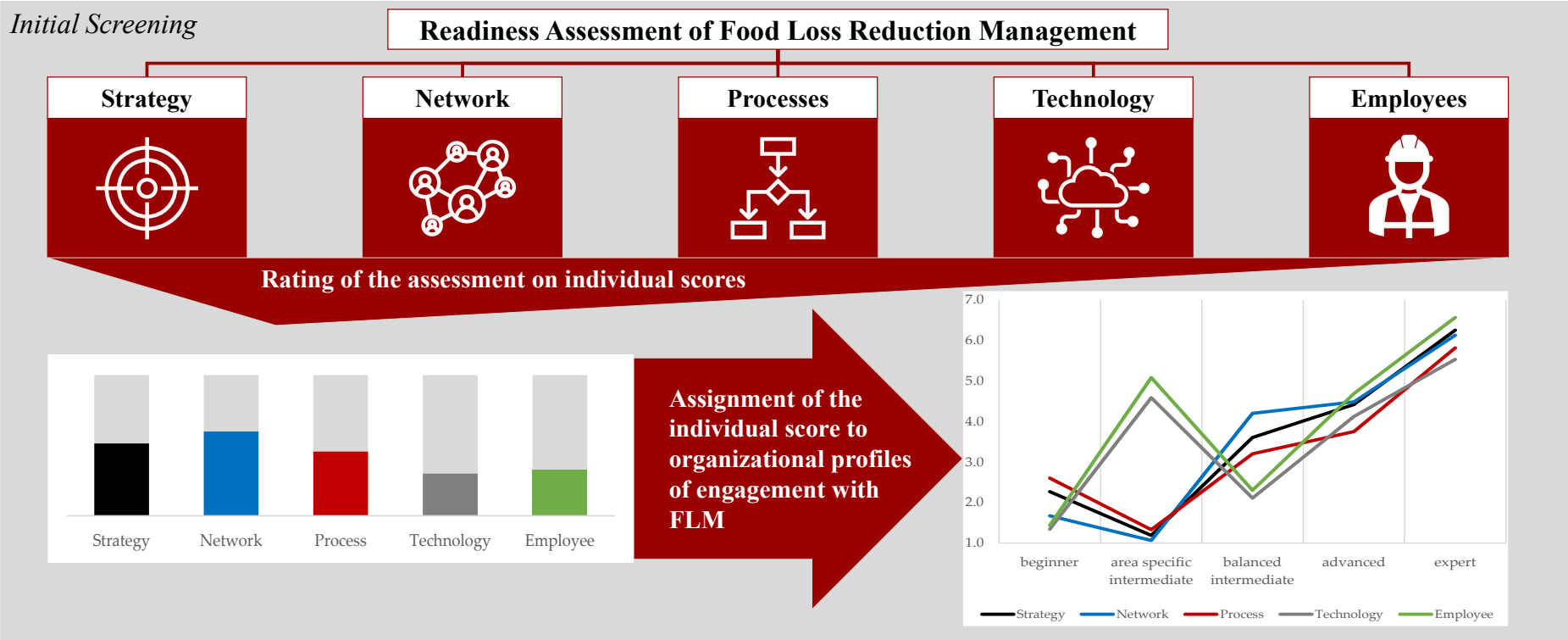

Figure 46 - Initial Screening of the Management model

6.2 Analysis phase to identify causes of losses and quantify loss amounts

For the successful reduction of food losses, it is essential to know the causes of the losses. The research showed that many organizations in the study area implemented measures without a clear picture of the causes and amounts of losses in their processes. Although implementing measures without prior analysis may lead to selective success and loss reduction, such an approach may miss important causes of losses. It is also possible that measures are developed for supposed loss sources that actually have a different origin. It is also possible that loss sources are addressed that are marginal compared to other existing loss sources.

Due to these facts, the second phase of the model presented here consists of the analysis phase. Through the preceding initial screening, the organization already has a clear picture of its previous dealings with food loss reduction management and knows the framework in which it should strive for activities in this area. As described, the system boundaries of food loss reduction management should be defined according to the respective profile affiliation. Within these boundaries, the analysis of causes and the recording of loss quantities are also to be carried out. The main question here is whether the organization is limited to its own organizational boundaries or is already at an advanced stage of addressing the issue and should therefore expand its focus to include its direct network partners or even the entire network it overlooks. The further organizations go beyond their own organizational boundaries in the analysis, the more they have to involve the respective network partners and convince them of the relevance of food loss management in general and the necessity of providing information in particular. Depending on how far advanced the network partners are in the discussion, this step can vary in scope and be associated with greater time expenditure in each case.

Once the system boundaries have been determined and all the necessary network partners have been convinced to carry out the analysis, the first step is to identify the loss quantities. For this purpose, it is suggested to record the loss quantities in kilograms [kg]. Generally, it would also be possible to use other measures for loss quantification, such as volume or calorie count. As a matter of fact, the food industry already uses kg as a measurement unit for many other processes. It can therefore be assumed that no additional quantification procedures or conversions are necessary for recording in this unit of

measurement. Volume changes are particularly problematic in process steps in which transformation processes take place on the production due to further processing or due to changes in condition during storage. To a certain extent, this also applies to weight, since drying during storage, for example, can also result in a change in weight. Nevertheless, as described, these weights are usually already recorded as measured variables and therefore the weight changes in these cases are easier to understand. An evaluation in calories usually requires additional calculations and cannot be reasonably applied to all foods, such as coffee beans. In addition, this measure is not intuitively comprehensible to the people involved in the processes. As already mentioned at various points in this dissertation and further elaborated in the following, transparency is one of the most important factors for the success of food loss reduction management. A measure that is easily visible and comprehensible for the people involved in everyday handling already contributes to improved transparency.

Thus, all processes within the system boundaries should be defined. Here it is important that these processes are defined in direct succession so that no losses between two processes can be overlooked. By means of an input-output comparison, these processes are examined with regard to their loss quantities. For this purpose, the quantity, i.e., the weight in kg, of the foodstuffs introduced into the process should be recorded. From this, those weight changes in kg should be subtracted which, according to experience, result from passing through the process in a professional manner. This gives the expected output quantity of the process. Furthermore, the output quantity in kg that actually results at the end of a process should be recorded. The difference between the expected output quantity and the actual output quantity in kg results in the loss quantity of the process. This logic is represented by the following formula:

$$I - W = O_e$$

$$O_e - O_a = FL$$

Whereby applies:

$$I \triangleq Input\ quantity\ in\ kg$$

$$C \triangleq Expected\ weight\ changes\ in\ kg$$

$$O_e \triangleq expected\ output\ quantity\ in\ kg$$

$$O_a \triangleq actual\ output\ quantity\ in\ kg$$

$$FL \triangleq Food\ losses\ in\ the\ analyzed\ process\ in\ kg$$

This results in a food loss quantity for each defined process within the examined system limits. In the sense of a long-term improvement process, these should be documented in a traceable manner in advance for each execution of this analysis. It should be noted that performing this analysis once may miss possible losses if their causes are, for example, weather-related or depend on some other temporary cause. In this case, it may help to repeat this process at different times to capture as clear a picture of the conditions as possible.

After the actual losses have been recorded, the causes of the losses can be addressed. For this purpose, every process for which a FL value greater than zero has been identified should be investigated.

The causes of losses can vary depending on the process. Likewise, they are always dependent on the previous process design and the actual implementation of the processes. Accordingly, no generally valid overview of all possible causes of losses can be presented within the scope of this dissertation. Nevertheless, through the analysis conducted in the context of this dissertation in East Africa, various causes of losses for different processes could be identified, which can be used as reference points for the analysis. These have been shown to be causes which can be dealt with through logistical measures. Thus, the following overview represents a collection of causes that occur in different processes of food value networks in East Africa and can potentially be prevented or mitigated by logistical measures. However, other root causes may also exist in East African food value networks, which are not listed here. **Figure 47** presents these by assigning them to functions within a food value network, which are explained in more detail below.

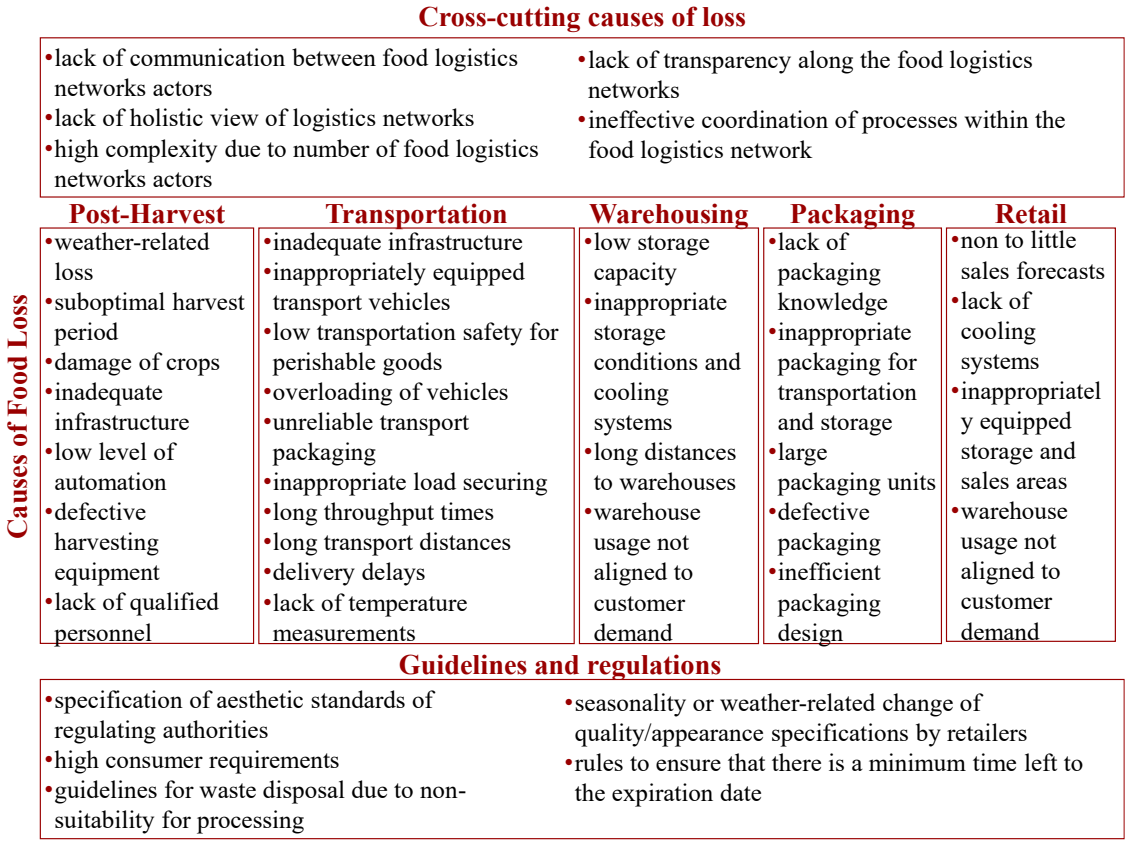

Figure 47 - Causes of losses by function within a food value network

There are some causes of losses that are of an overarching nature and therefore cannot be directly assigned to functional areas. These include the lack of communication between network partners and the high complexity due to the number of players within the logistics network. A highly complex system, such as the food value networks referred to, requires a considerable amount of coordination to distribute information to all relevant network partners. This can lead to actors making decisions based on this lack of information that result in losses either directly to them or to downstream points in the network. This can also occur if individual actors lack a holistic understanding of the logistics network. Thus, decisions cannot be evaluated in terms of their impact elsewhere in the network, producing losses. Even if there are already coordination efforts between network partners, this process, if ineffective, can lead to losses. All of these issues often result in losses that cannot be located at the point of the actual decision. For this reason, it is particularly relevant in root cause analysis to take as broad a view as possible of the entire network, but at least of the entire system under study, to identify the actual causes.

The investigations in the context of this dissertation have shown that in the study region of East Africa, the loss figures in the post-harvest processes are estimated to be particularly high. Here, particularly weather-related losses are mentioned. These include, for example, storage in the sun after harvest while waiting for pickup by the transporter. Storage in storage facilities exposed to the weather also counts towards this point. Another point that is often mentioned is manual damage to the food due to post-harvest handling. This can include the improper touching of the food as well as the use of tools or machines that are not suitable for the food, for example in packaging for further transport. Here, the low standard of automation can also be a reason for losses and damages. It should be noted that damage in a post-harvest process does not necessarily have to be quantified as losses at this stage as well. The damage may also only be noticed in a subsequent step and registered as losses there.

During the transport processes, the existing infrastructure can cause losses due to mechanical influences exerted on the food, e.g., by driving over holes in the road. Likewise, the infrastructure can cause transport times to be extended, thus affecting the food. Improper transport vehicles and means of transport can also generate losses. This includes improper transport packaging. The type of loading can also cause losses or damage due to mechanical impact. The absence of refrigeration equipment or its failure can also lead to losses.

Various typical types of causes were also found for storage processes during the analysis. For example, insufficient storage capacity can lead to improper storage, which can cause damage to the food. Furthermore, different foods place different demands on storage conditions, each of which must be considered. Failure to take this into account can also be a cause of losses. This includes, for example, maintaining a certain humidity, temperature, or air composition. In addition, the selected storage strategy, if not matched to customer demand, can lead to losses.

At various points in the network, problems with packaging can lead to losses. These include, among others, a lack of knowledge about the necessary packaging for the respective foodstuffs among the employees in charge of packaging. In addition, the selected packaging must be suitable and coordinated for the subsequent transport and storage processes. If this is not ensured, mechanical damage or damage due to non-

compliance with transport or storage conditions may occur, among other things. The wrong choice of packaging unit size can also lead to losses if, for example, batches with different expiration dates are packed together. The same applies to the use of damaged or otherwise defective packaging materials.

In the retail sector and in sales processes in general, causes of losses can also be identified. Here, missing, or incorrect sales forecasts can lead to surpluses, which then generate losses. Likewise, the failure or absence of cooling systems can lead to losses. The same applies to sales areas that are inadequately equipped to meet food requirements.

In addition, there are also causes of losses that do not lie directly within the sphere of influence of the active players in the food value network. This refers to causes that arise due to regulatory intervention. These may include requirements for aesthetic standards, guidelines for the contamination of food with chemicals, or regulations to ensure a minimum time until the expiration date at the time of sale to the end consumer. These causes of losses should also be captured in the analysis. They cannot be eliminated by one organization alone because of their regulatory nature. Nevertheless, they can be brought to the attention of the regulating entities and a dialogue with them can occur as a result. This can also be a focus area in the development of measures.

This reflects known frequently occurring causes of losses in the respective functional areas. It must be pointed out here that this is not a definitive list of causes, but that there may be other functional areas in food value network in which causes of losses not mentioned here occur. In addition, further causes of losses can also occur in the functional areas mentioned here, which have not been mentioned here. This may be due to special features of the respective foodstuffs, to the special design of the respective processes or to other factors. It is therefore necessary to conduct an intensive analysis of the processes beyond the causes mentioned here. To analyse these processes, an Ishikawa diagram can be used to map the cause-effect relationship between the losses and the process components. It is useful to work at the same levels used for readiness self-assessment or logistic trend analysis. Accordingly, the Ishikawa diagram should be used in the following dimensions: Employees, Processes, Technology, Strategy, and Network. **Figure 48** shows an example of such an Ishikawa diagram.

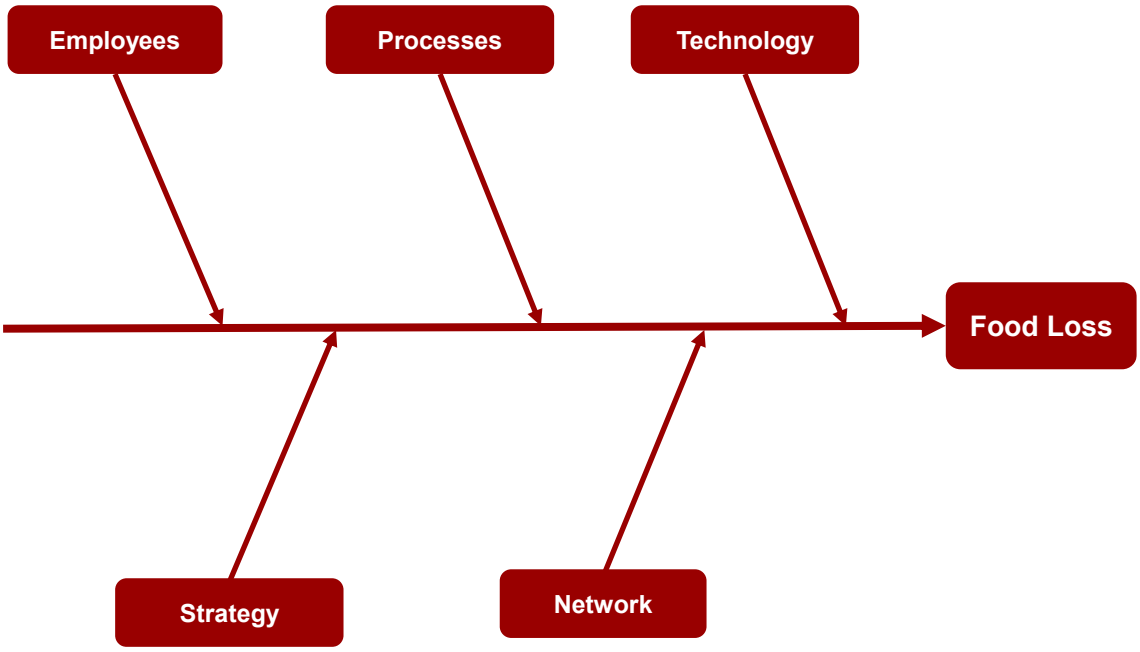

Figure 48 - Example of an Ishikawa diagram for identifying causes of loss

The influencing factors processed in this structured way allow the causes of the losses to be determined. Thus, the organization can determine the causes of losses for all processes. Together with the grouping into an organizational profile, this is the basis for the subsequent development of measures to reduce losses.

6.3 Selection of activities by selecting the fields of action that match the organizational profile

In the studies conducted for this dissertation, the participating companies, in addition to carrying out the readiness assessment, provided an assessment of which fields of action they consider useful for their current status, or which measures they have already implemented. Parts of this assessment have already been presented in chapter 5. In the following, we will discuss in detail how the prioritization of the fields of action for the individual profiles should be carried out according to the assessment of the organizations as well as the assessments of the observing researcher.

In chapter 3 of this dissertation, fields of action were identified from the literature as well as through interviews, which summarize different measures that pursue the same objective with regard to the improvement of a certain aspect in the food value network in order to ultimately reduce losses. This is necessary because the measures themselves, as well as the causes, in most cases cannot be applied across the board for all types of food and for all structures presents. Nevertheless, in order to provide guidance for the development of measures, the approach chosen was to identify overarching areas for action. These can be used by the organizations to then develop concrete measures in this field of action on the basis of their own structures, state of conflict as well as the result of the cause analysis. It should also be noted that these fields of action do not claim to be disjoint. Measures can exist that can be assigned to several fields of action because they pursue different goals. In addition, measures can exist or be developed by the organizations that cannot be easily assigned to one of the 13 fields of action. Since the fields of action are based on measures that have already been implemented and mentioned in the literature or in interviews, it is possible that these fields of action do not cover the entire solution space of measures. However, since they are not used as guidelines in this context, but rather as orientation aids, they nevertheless fulfil the purpose for which they were developed in the context of this work. The fields of action discussed below are summarized in **Figure 49**.

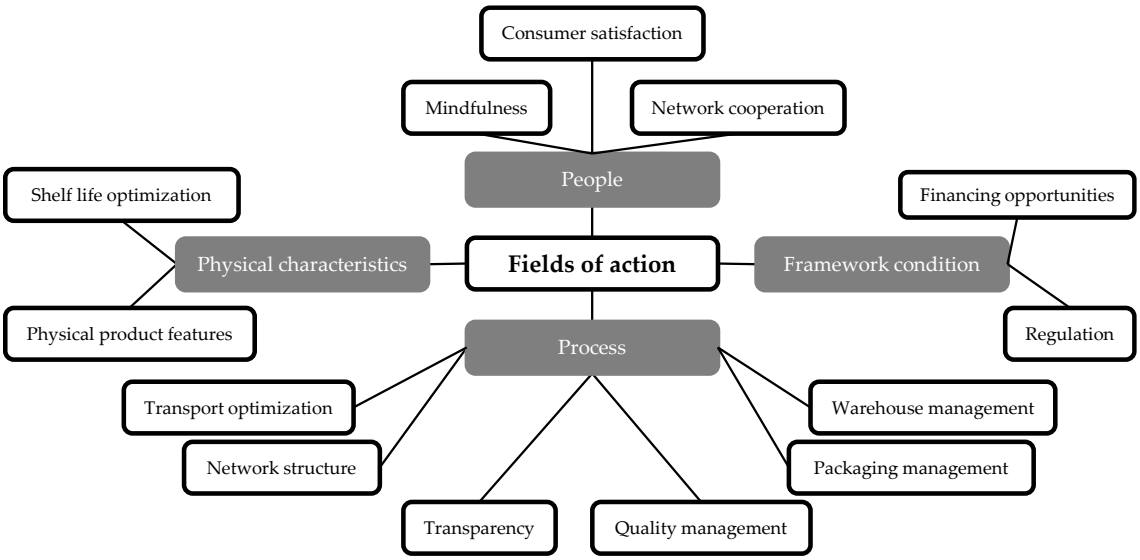

Figure 49 - Fields of action for the reduction of food losses

The 13 identified fields of action were grouped into 4 upper categories. It should be noted that the fields of action in the category "Framework conditions" do not lie within the sphere of influence of the organizations in focus in this dissertation. These describe measures that can be taken by the regulatory level. These include, on the one hand, measures in the "Financing opportunities" field of action. These describe financial support measures for active players in the food value networks that enable them to reduce losses. Furthermore, this category includes the field of action "Regulation" which describes adapted regulations by the regulatory level to support the organizations in reducing food losses. Since these fields of action are not within the sphere of influence of the organizations that are to be supported by the present management model, these two fields of action are not mentioned in the following when it comes to the self-assessment and the assessments of the observing scientists.

The "People" category comprises three fields of action. These include the "Mindfulness" field of action, which combines measures that focus on promoting awareness among employees at all levels of the company of the importance of the problem of food losses in everyday life. In addition, the "Network cooperation" field of action also belongs to this overall category. This includes actions that help improve cooperation within networks, including information sharing and efforts to develop comprehensive food loss policies. The third field of action under this category is "Consumer satisfaction." This groups together measures that focus on adapting internal processes with the aim of

meeting specific customer requirements. This includes, for example, measures aimed at requirements such as regionality and seasonality.

The "Physical characteristics" category comprises two fields of action. The first is "Shelf-life optimization". This includes measures that focus on process adjustments that enable the shelf life of products to be taken into account in decision-making. On the other hand, is "Physical product features". This refers to measures that implement process adaptation to the specific physical requirements of the products, including temperature, pressure sensitivity and air composition.

The "Process" category comprises six fields of action. One of these is "Transparency". This includes measures to increase transparency both within an organization and between organizations in a food value network. Another field of action is "Quality management", whose measures for improving quality management lead to the early detection of weak points. The "Packaging management" field of action summarizes measures aimed at improving packaging management during transport and storage processes and during distribution to the end customer. The field of action "Transport optimization" aims at improving transport management with regard to route planning, loading of vehicles and coordination of vehicles. The field of action "Warehouse management" summarizes measures that lead to the improvement of warehouse management through suitable warehouse facilities, warehouse strategies and adapted layout planning. Finally, the field of action "Network structure" should be mentioned, which pursues the improvement of the network structure through strategic network planning and location management.

For the selection of measures, organizations are therefore required to concentrate on those fields of action that fit their framework conditions. In this way, an orientation towards the fields of action is suitable, which organizations with the same organizational profile have applied, would apply, or should apply according to the assessment of the observing scientists. As already mentioned, organizations were asked, depending on their organizational profile, which measures they have already implemented or plan to implement, as they consider these to be useful measures for reducing losses in their own processes. **Table 8** shows the percentage of organizations in the profile that report that this area of action is already the focus of their activities. Multiple responses were possible here.

Table 8 - Relevance assessment of the fields of action in relation to organizational profiles

	Beginner profile	**area specific intermediate profile**	**balanced intermediate profile**	**Advanced profile**	**Expert profile**
Mindfulness	**50%**	**50%**	11%	25%	50%
Network cooperation	13%	**67%**	**67%**	**75%**	**75%**
Consumer satisfaction	25%	33%	44%	42%	50%
Shelf-life optimization	13%	0%	33%	17%	50%
Physical product features	38%	0%	22%	8%	**67%**
Transparency	**75%**	33%	**57%**	**67%**	**75%**
Quality management	**50%**	**67%**	44%	**67%**	63%
Packaging management	13%	33%	33%	42%	50%
Transport optimization	**50%**	33%	**67%**	42%	63%
Warehouse management	38%	**67%**	44%	33%	63%
Network structure	25%	33%	11%	33%	**75%**

It should be noted here that some of the organizations stated that, if these measures had already been implemented, they had not done so with the intention of reducing losses. In the course of implementation, it was found that losses could also be reduced. This was reported primarily by organizations with the profiles Beginner, area specific intermediate and balanced intermediate. The organizations also rated the action areas according to the effectiveness fitting to their current situation. This included that only past actions should be included, which would theoretically still make sense for the current state of the

organization to reduce losses. Thus, a link to the organizational profiles can be established.

For the Beginner profile, the most relevant fields of action are Mindfulness, Transparency, Quality management and Transport optimization. With regard to the analysis of weaknesses for this profile, this assessment coincides with the fields in which these organizations show the greatest weaknesses. Here, mindfulness and transparency stand out above all. According to the readiness assessment, the organizations show the greatest deficits in these areas. Likewise, both fields of action are to a large extent basic prerequisites for further steps and the success of other fields of action. For this reason, organizations with the Beginner Profile should focus primarily on these two areas of action. In doing so, Mindfulness should be related to the employees in operational processes as well as to the management level. As already mentioned, several times in this dissertation, it is indispensable that the management level is aware of the relevance of the reduction of food losses and that they incorporate this into their decisions, but also that they exemplify this relevance to the employees. On the other hand, employees in operational processes must also have the right awareness of this topic so that they are able to assign appropriate relevance to this topic in their direct dealings with food. Concrete measures here can include training by external experts. Regarding Transparency, the main issue here is to create transparency about current loss quantities and their causes. The implementation of this management model provides the basis for this if, as is the case in most organizations with this profile, it did not previously exist. However, it must also be ensured that this information is also distributed appropriately and explained accordingly to the respective context of the employees. Concrete measures in this context could be, for example, the introduction of information boards, but also the introduction of information systems that provide employees directly with the relevant information. The topic of Quality Management in this case relates primarily to the introduction or monitoring of compliance with process standards in operational logistics processes. Here, the organizations note that in many cases unskilled workers are employed in the operational processes in the region under investigation, and that this sometimes leads to difficulties and, as a result, to losses because these employees are not familiar with the process standards or are not used to adhering to such specifications. In the area of transport optimization, the actions for organizations with this profile focus primarily on

the topic of loading vehicles. Here it is also addressed that the lack of process and product knowledge of unskilled or seasonal workers leads to incorrect loading and consequently to losses. Measures are also recommended here to impart the missing knowledge and to define corresponding process definitions that can be implemented by the employees.

When looking at the area-specific intermediate profile, the fields of action Network cooperation, Quality management, Warehouse management and Mindfulness emerge as the most frequently mentioned fields of action. It is noticeable here that these organizations are particularly distinguished in terms of the profile analysis by the fact that they already have very good relationships and cooperation with network partners. The nevertheless high assessment of the potential of this field of action suggests that these organizations know the network partners so well that they are already aware of the concrete measures or areas of application for measures that would lead to improvements in this field. This is where these organizations would be able to play to their existing strengths and build on them. The analysis of weaknesses for this profile showed that these organizations have shown little focus to date, particularly in the areas of strategy and process. The process aspect in particular is reflected in the fields of action warehouse management and quality management. In both areas, the organizations see potential in operational measures in these fields of action to reduce food losses. In contrast to the organizations with the Beginner Profile, however, the focus here is not on imparting knowledge to employees on how to comply with standards, but on introducing specific process steps. Here, under quality management, for example, additional control points within the logistics processes are addressed, which enable the early detection of possible changes to the food. Regarding warehouse management, it is mainly warehousing strategies that are addressed. The organizations report that so far predominantly no fixed storage strategies apply or partly use last-in-first-out. Here, much potential is seen to reduce losses by introducing first-in-first-out or even first-expire-first-out. The field of action Mindfulness is seen by these organizations especially with regard to integration into the management levels. Here, the organizations state that they have already raised employee mindfulness to a high level, so they do not see any direct added value for loss reduction in this area. However, they state that management levels do not sufficiently consider this issue and incorporate it into their decisions. Thus, expert training of these

levels is seen as having great potential to implement food loss reduction as part of the organizational strategy.

The survey of the organizations with the profile balanced intermediate revealed the highest estimated potentials for the fields of action Network Cooperation, Transport Optimization and Transparency. The Network Cooperation field of action reflects the fact that these organizations are taking the first steps to cross their own organizational boundaries in food loss reduction management and to initiate projects with network partners in this area. Here, the organizations mainly indicate activities and measures that better coordinate processes with network partners so that losses due to process interruptions or uncoordinated activities can be avoided. These organizations set a similar focus in the area of transparency. Here, however, they focus on two sub-areas. The first is the promotion of Transparency in processes with network partners. In other words, the goal is to provide partners with as much relevant information as possible and, at the same time, to obtain all necessary information from partners that can promote a reduction in losses. At the same time, these organizations also see the need to improve transparency within their organization. Here, the provision of information to employees in operational processes is the main issue mentioned by the organizations. Compared to the organizations with the Beginner profile, these organizations seem to already provide the management level with information well and therefore no longer see their need for action at this level. In the area of transport optimization, these organizations state that they see particular potential in route optimization and similar tactical measures. Here, too, there is a clear difference in the objective with which the field of action is addressed compared to the group of organizations with the Beginner profile, although the same field of action was named here.

Organizations with the advanced profile see the greatest potential in the areas of network cooperation, quality management and transparency. Here, there are some differences with the information provided by the organizations with the balanced intermediate profile. Both see their own weaknesses primarily in the area of processes. The organizations of the advanced profile, however, emphasize quality management as more important than transport optimization. Here, emphasis is placed on the quality standards of processes and measures are aimed at improving these and reducing losses as a result. The area of network cooperation is very similar to the previous profile. The organizations have

already taken initial steps together with network partners and see great potential for eliminating causes of losses through improved coordination of processes between network partners. In the area of transparency, the organizations focus very strongly on the network partners. Transparency within the organization is relatively advanced at all levels considered in the assessment. This suggests that these organizations have recognized the relevance of transparency overall and now want to extend the advantages created internally to interaction with network partners.

For the Expert profile, it should generally be noted that overall, the potential for measures across all fields of action was estimated to be higher than in the other profiles. This indicates that the organizations have a very good general understanding of the problem and are therefore more likely to see the potential for improvement than organizations that have not yet dealt with this topic so intensively. These organizations cite transparency, network cooperation, network structure and physical product properties as the most relevant areas for action. The transparency addressed here refers primarily to the network level and, unlike the profiles addressed so far, goes beyond the direct network partners. These organizations already have such well-established processes and information exchanges with the direct network partners that they want to focus their attention on other parts of the network. The fact that the causes of losses are not necessarily found at the network level where the losses are registered plays a role here. Thus, these organizations display a particularly high degree of foresight and thus attempt to increase transparency not only within their direct sphere of influence, but across their entire network. The situation is similar with the field of action of network cooperation and network structure. Here, the organizations also focus on the network level with the aim of changing their networks to such an extent that structural causes can be eliminated. Here, the relocation of production sites to the region under investigation is mentioned above all. The goal here is no longer to transport the raw products over long distances, but to relocate the production sites as close as possible to the generation sites. In addition, these organizations see great potential in the implementation of measures in the field of physical product properties. The focus here is on measures to adapt processes to the special physical requirements of the products, including temperature, pressure sensitivity and air composition. Above all, temperature control throughout the entire process is cited by the organizations as an important measure.

Regarding the genesis of an organization that addresses the topic of food loss reduction holistically, three evolutionary stages can be derived on the basis of the findings described so far with regard to the focus of activities.

The basic prerequisite for any successful reduction of food losses across organizational boundaries is that the respective organizations have a fundamental understanding of the challenge of food loss reduction management. If critical causes of losses have not been eradicated within an organization, cross-organizational activities will not be able to achieve the same effect as if the organizations had each created the best conditions. It is therefore advisable that organizations focus on internal processes in the first step of food loss reduction management. Regarding the prioritization of activities, or which target functions should be primarily addressed, the Knowledge-Based View (KBV) theory of science is used. According to KBV, it is fundamentally relevant to integrate the necessary knowledge for all functional areas essential to the organization within the organization. Here, special emphasis is placed on providing the organization's employees with this knowledge.

In the context of food loss reduction management, as a basic building block, all employees must be provided with the necessary information so that they can best reduce food losses within their sphere of influence. To properly apply this knowledge, the organization's employees must also have an extensive understanding and awareness of problems. Teaching and deepening this are also an important foundation for successful food loss reduction management.

In the context of East Africa, this aspect is particularly relevant, as many companies work with seasonal workers and day laborers. Due to this volatility in the workforce of the organizations, it is on the one hand a challenge to build up the required mindset regarding extensive problem understanding and awareness among the employees in the long term. On the other hand, the build-up of knowledge, which is a necessary basis for successful food loss reduction management, is more difficult to build among employees who are not permanently employed. Thus, to optimize food loss reduction management regarding the basic requirements, organizations should do without seasonally employed staff in the long term and build up a core of employees who are taught the corresponding scope of knowledge and skills. If it is not possible to hire seasonal employees on a long-term basis

due to the structures, a comprehensive compact training on food loss reduction management should be implemented for the seasonal employees.

Having laid the foundation for successful food loss reduction management through extensive problem understanding and knowledge building, organizations should focus on conducting a comprehensive analysis of the causes of losses that exist within the organization. In this consideration, the organization should first be understood as a system and no focus should yet be placed on causes external to the organizational boundaries. This is advisable to avoid making the analysis too complex. Focusing on the organization's direct sphere of influence helps to primarily address those causes that can be eliminated by the simplest measures.

This means that organizations should primarily focus on implementing measures that require little or no financial or human resources when optimizing food losses internally. In most cases, these are measures that focus on the tactical organizational level and tend to concern the implementation of processes. Once the potential of this level of action has been exhausted, more complex solutions can be implemented. For this purpose, the focus remains on internal organizational processes. However, the solutions can become more complex and involve more extensive process or structural changes.

Depending on the general state of digitization in the organization, it makes sense at this point to use digital solutions that help reduce the causes of losses. These include, for example, decision support systems that allow better planning through forecasts. But also, the use of sensor technology, for earlier detection of product changes, to shorten the shelf life, would be a possible use at this stage. However, the concrete use of digital technologies in this context must always be oriented to the context of the organization and the concrete use case. In the context of organizations operating in food value networks in East Africa, this also means always considering the structural framework conditions such as power supply, availability of Internet as well as IT infrastructure.

Once the internal organizational structures are established, organizations can direct their focus in food loss reduction management to the direct network partners. This prerequisite is derived from the observation that organizations usually do not achieve any significant added value from cross-organizational cooperation in terms of reducing food losses if the basic structures have been established within the organization. Thus, the added values of

cross-organizational cooperation result in significant part from the fact that losses within an organization can be reduced that have been caused by actions in the network stages in question. If, however, the right conditions have not been established within the organization, the competence to use these potentials optimally is missing.

Cooperation between direct network partners also creates transparency. With an improved level of knowledge about processes and process-related framework conditions, partners can coordinate their actions and thus eliminate the causes of losses resulting from a lack of coordination. In this context, particular attention should be drawn to those losses that occur when products are quickly passed on by one network partner and then cannot be further processed by the next network partner due to process-related conditions. Thus, the first partner has reduced the losses with itself, but this has only been shifted to another place in the overall systemic view. For example, it was observed that some companies have already introduced FEFO (first-expired-first-out) as part of their efforts regarding the reduction of food losses. However, the network partners were not aware of this and therefore did not adjust in their own operations. In some cases, this led to products that were to be further processed being in an overripe state and no longer usable for production.

The reduction of losses at one network partner therefore resulted in increased losses at a later stage in the network due to a lack of coordination and communication. By intensifying communication about processes, partners can jointly develop solutions or coordinate their processes in such a way that these losses can be reduced for the overall system.

In addition to creating transparency through intensified communication, active collaboration on loss reduction projects is important for holistic reduction. In this context, the network partners, who have the greater power position in the network, are of particular importance. They are the ones who support the smaller network partners. According to the integrative business ethics already mentioned, it is the responsibility of companies that have greater influence on network partners to use this influence to create added value for society as a whole, i.e., for the reduction of losses considered on this occasion. In this context, it is also their responsibility to use the resources available within their framework to support network partners in their efforts. This can be done both through financial

support and through personnel support, for example in providing opportunities for education and training.

In this case, the focus is also on questioning previous forms of cooperation. If one party has a greater position of power, it will in many cases also exploit this to gain an advantage for itself. In the food industry, particularly in the context of organizations in developing countries, this often leads to financially constraining situations in which the organizations involved are unable to implement activities outside of those that are directly beneficial to the core function of the organization. Consequently, in this case, it is particularly important in cooperation with network partners to analyse the previous dependency structures and to build new structures that are oriented toward increasing the benefit for the common good and not only towards increasing the benefit for individual organizations. Organizations that are aware of these relationships also consider vertical integration. In the respective cases, this can help create better conditions for local organizations and reduce transaction costs overall.

Once the cooperation of the direct network partners has been brought to a good level, the focus can be placed on the indirect network partners. The task becomes for all network partners to rethink the structure of the network to eliminate structural causes of loss. Since most foodstuffs have a longer shelf life in a processed state than in an unprocessed state, the task in this step is to relocate processing steps as far as possible to the beginning of the value network. In the context of this dissertation, this includes the relocation of production to countries in East Africa.

Since losses in the area under consideration are also caused by inadequate infrastructure and a lack of means of transport, it is particularly important here to keep these transport routes as short as possible or to simplify the requirements that the food places on transport through further processing. Based on the observations for fruit and vegetables, drying can be a successful further processing step in the country of origin. This requires relatively low expenditure in terms of training of employees and can be operated by modular equipment and locally generated energy, or by small solar panels. This allows farmers or cooperatives to carry out processing directly on their land, regardless of other infrastructural requirements. This measure not only leads to a longer shelf life of the food, but also has the additional effect that the food is processed directly at the producers, and

they can therefore achieve a higher price for the products. Consequently, the local economy is directly strengthened by this measure.

In addition to direct processing at the producer's premises, more complex refining steps or further processing according to the same logic must also be investigated regarding their feasibility in the countries of origin. Taking coffee from Ethiopia as an example, it can be noted that less than one percent of exported coffee is roasted (GIZ 2021). When transporting green coffee, the temperature and humidity must be kept within a certain range to prevent losses, especially due to mould growth. Well-packaged roasted coffee places significantly lower demands on the transport environment. In addition, roasted coffee loses weight by reducing its water content. As a result, from a food loss reduction management and logistical point of view, it makes a lot of sense to transport roasted coffee over longer distances instead of green coffee. In addition, various estimates suggest that export profits for Ethiopia could be increased by between approximately 60% and up to 2000% if roasted coffee were transported instead of green coffee while export volumes remained constant (Solino Coffee 2014; World Bank 2014). In addition to the additional dividends that would be collected in this way, which are urgently needed in the country due to the economic situation, other positive effects would be achieved for the country. For example, higher-value employment would be created by the new production sites. This leads to newly created jobs, which are currently urgently needed due to the rapidly growing young population. Furthermore, increased industrialization and professionalization in the coffee sector would lead to the development of competencies for the maintenance of machines in the country, which for other sectors would create a framework for further steps towards the establishment of industry and production sites. Especially in an economy like Ethiopia, but also in the other East African countries whose economies are today largely dependent on agriculture, steps toward greater industrialization can have spill over effects for other sectors and industries.

To achieve a development as outlined in this example of Ethiopian coffee, it is of enormous importance that large companies in Western countries recognize and acknowledge this potential as well as their responsibility for society as a whole, which is derived from integrated business ethics. They either must relocate their own production facilities in cooperation with the local actors or have the task to support the local partners in building up these structures. Above all, however, it is their task to use their position of

power in the sense of food loss reduction management if the potentials are to be used in the sense of the common welfare. This requires a rethinking of these companies away from a pure profit orientation to a sustainability orientation, which in the classic understanding of the term includes economic, ecological and social dimensions equally. Here, the focus must be on an equal consideration of these dimensions, with none taking precedence over the others. This signifies a paradigm shift in the way companies today operate and act in the international markets. Today, the actions of these companies clearly show that profit orientation, and thus the economic view, is given greater weight over the other dimensions. As described, the potential of food loss reduction management cannot be fully exploited in this way.

The entire process described in the management model should be carried out on a recurring basis in the sense of a continuous improvement process. Particular focus should also be placed on the sustainable implementation of all measures. Losses can only be sustainably reduced if the measures are implemented in the organizations with a lasting effect.

6.4 Summary of the logistic management model for food loss reduction in East African food value networks

As presented, the logistic management model developed here consists of three stages, which are designed as a recurring improvement process. The logistic management model fulfils the goal of supporting organizations in East African food value networks in reducing food losses through the use of logistical measures. For this purpose, a readiness assessment is conducted in the initial screening stage of the model. This tool is one of the core results of this dissertation. It is based on the fact that although there is a basic understanding of the problem of food losses in the organizations in East African food value networks, they are largely unable to quantify the losses in their own processes, nor do they know their own prerequisites within the organization to address this problem. The Readiness Assessment was developed to address this issue (see chapter 4). On the one hand, it builds on the barriers that prevail in East African food value networks with regard to addressing food losses. On the other hand, it is guided by the logistics dimensions of addressing trends in logistics developed by Handfield, Straube, and Pfohl 2013. Thus, a tool was developed to determine the current engagement status of an organization in East African food value networks with food loss reduction management by querying qualitative statements in the five dimensions of strategy, people, technology, process, and network. The questionnaire for this can be found in the appendix of this dissertation. Also, as part of this dissertation, organizational profiles for engagement with food loss reduction management based on the readiness assessment were developed based on a survey of organization in East African food value networks (compare chapter 5). Within the model, an assignment to a suitable organizational profile is specified after the assessment has been applied.

On this basis, assignments are made as to which system boundaries the organization should focus on food loss reduction management. A key question is whether the organization should focus on internal processes or work together with network partners on loss reduction. According to the logic of the model, this depends on the previous engagement with the topic, which is analysed in the readiness assessment. In the second phase of the model, the analysis of the loss quantities and the causes of losses is performed. Here, the analysis is performed within the system boundaries defined in the

previous step. Here, a process definition is made at the beginning. For this purpose, all physical processes through which food passes within the system boundaries are identified.

Subsequently, the input quantities of the foodstuffs in kilograms are recorded for all processes. Subsequently, the expected output quantity is recorded based on the respective processes. This is necessary because some processes result in weight changes that would otherwise be incorrectly registered as losses. These include, on the one hand, production-related weight reductions such as the removal of unforgivable components such as shells and kernels. But also, the weight losses that occurs during storage or transport due to progressive drying must be taken into account here. Subsequently, the losses that actually occur are noted. The difference between the expected output quantity and the actual output quantity are the occurring food losses. Next, the causes of the losses are analysed for all processes with a positive loss value. For this purpose, the model provides indications as to which causes could potentially exist in different processes. However, this step is highly individual and must therefore be carried out closely to the processes under investigation. Subsequently, the causes that can potentially be eliminated by logistical measures are pursued further within the framework of the model.

In order to prioritize which causes should be addressed first, the third phase of the model proposes suitable fields of action for food loss reduction management based on the assigned organizational profile from the first step, which were developed as part of this dissertation. Through this mapping, organizations can develop individually appropriate logistic measures for food loss reduction based on the identified causes, the recommended action areas, and the knowledge of how the processes have been carried out so far. This model is designed as a continuous improvement process. It is therefore intended that the organizations carry out this process at regular intervals. This is, on the one hand, to ensure the sustainable effect of the measures implemented. And on the other hand, to achieve a continuous improvement of the overall situation in terms of a food logistics network in East Africa with the lowest possible losses. **Figure 50** illustrates the model described above.

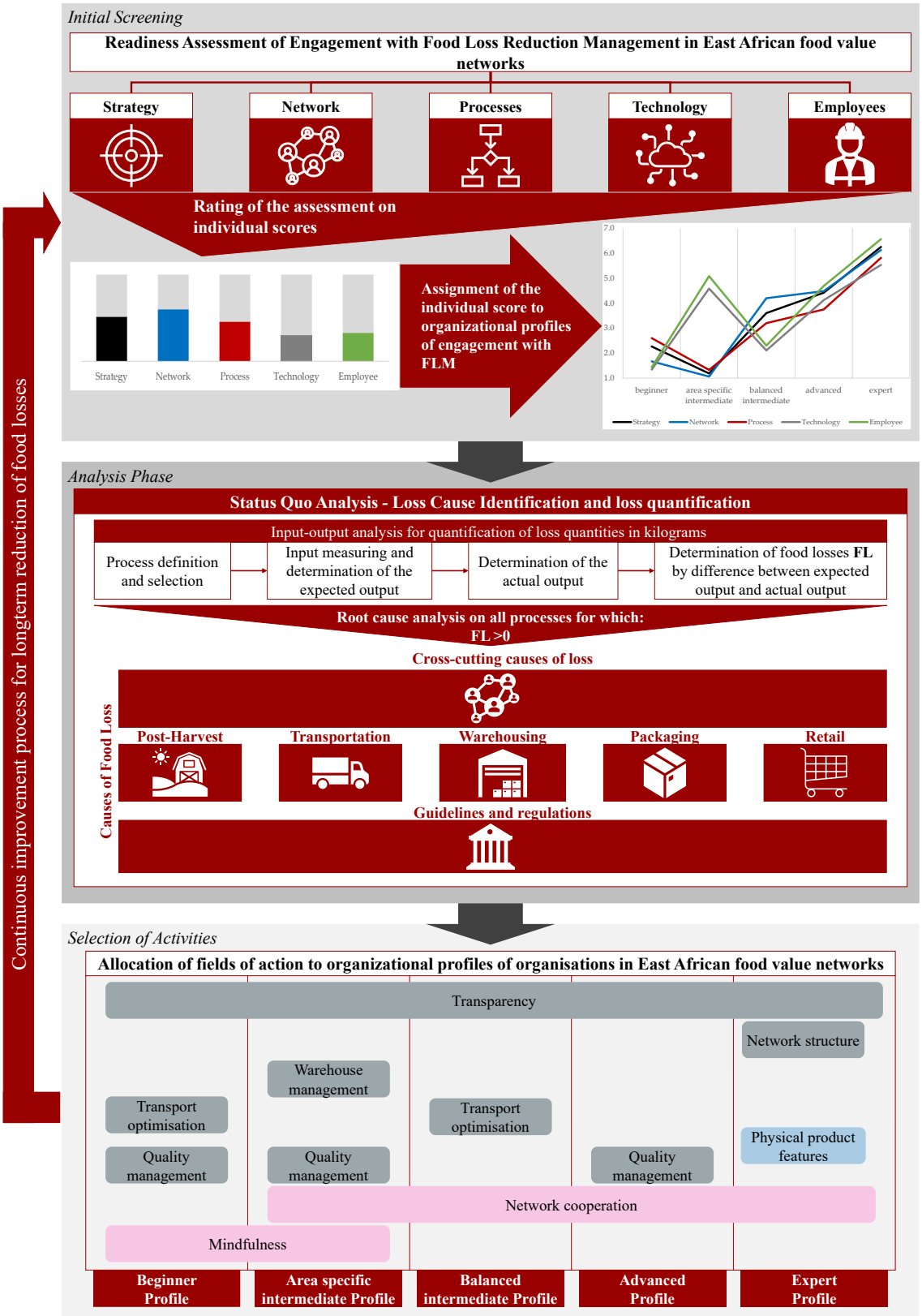

Figure 50 - Logistic management model for food loss reduction in East African food value networks

6.5 Exemplary implementation of the logistic management model for food loss reduction in East African food value networks

In the following, the exemplary application of the model is outlined using an exemplary company from an East African food logistics network and the resulting effects are discussed.

The company considered in the following is a producer of herbs, which produces in Ethiopia for the European market. The company acts both as a producer of the herbs and also takes care of the packaging and transport to the airport, where the goods are handed over to the transport service provider, who takes care of the international transport. Thus, this company is responsible for large parts of the local food value network itself. For the application of the logistic management model developed here, this company would now carry out the readiness assessment in the first step in order to record its own level of engagement. To do this, they would go through the questionnaire found in the appendix of this dissertation and rate the statements in the five categories in relation to its own structures on a scale of 1 (not applicable) to 7 (fully applicable). This evaluation results in a scale value for each category, which reflects the company's previous level of engagement within this category. Now the smallest deviation between the category values of the company and those of the profile values contained in the model.

This results in the assignment of an organizational profile. For the exemplary company, this would result in an assignment to the advanced profile. This organization is therefore already relatively far advanced in dealing with food loss reduction management and has already created some structural conditions to align the organization with regard to a low-loss design of the value network. According to the recommendations of the model, in the analysis phase that now follows, the company will not only include its own processes, but also those of its direct network partners. For this analysis phase, the company would now analyse all the processes through which the herbs physically pass. For each of these processes, the company registers the input quantity of the respective herbs in kilograms and the expected weight reduction within the respective process. From this, it calculates the expected output quantity. Subsequently, the company registers the respective output quantities of the processes that actually occur. The company then calculates the difference between the expected and actual output quantity of the herbs in the respective processes.

Thus, the company identifies all processes in which food losses occur. It must be taken into account that the company also examines the processes that are carried out at the direct network partners.

As described above, the most relevant direct network partner is the transport service provider who handles the international transport. It is therefore necessary to obtain the relevant information from the service provider. Difficulties can arise here if the service provider is not prepared to provide the necessary information. If the service provider cannot be convinced through good argumentation that providing the information will benefit all partners in the long term by reducing losses, the company could help itself by determining the output quantity in another way. Here, contacting customers in Europe could be a way to estimate the output quantity. They could provide figures on how many kilograms reach the customer after international transport. This would not allow the company to infer the individual processes at the service provider. However, it could approximately estimate the losses at these network partners.

In the second step of the analysis phase, the causes are now identified on the basis of the identified processes with losses. Here, the company would carry out the analysis with a cause-effect diagram according to the specifications of the model. Here, the analysis of the processes at the network partner can be considered as an example. As recommended in the model, the analysis is performed using the categories of the readiness assessment. At the employee level, the company determines that the employees involved in the process have not been adequately trained in the use of herbs. In addition, the analysis finds that there are intermittent problems with availability with sufficient staff to keep the process running smoothly. On the process level, it is determined that there are sometimes longer standing times of the herbs in the warehouses than are actually intended. It is also noted that there is no continuous process monitoring. On the strategy level, it is determined that there is little to no orientation to integrate innovations into the processes. The analysis of the technology level shows that the available cooling technology does not always work reliably. At the network level, it is found that the service provider is not always provided with enough information from the analysing company to adequately address the processes to the herbs and their shelf life. The described analysis results are summarized in **Figure 51**.

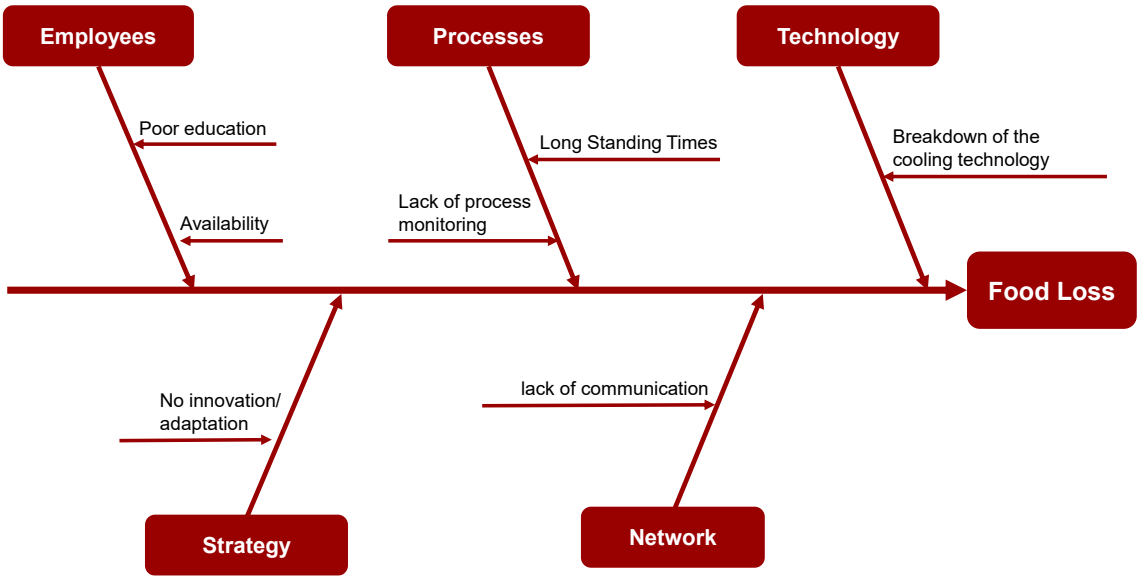

Figure 51 - Application of the cause-effect diagram to the analysis of the example company

Following the analysis phase, the company carries out the selection of measures. According to the logic of the model, a company with the advanced profile should concentrate on the fields of action network cooperation, transparency and quality management. In relation to the process at the service provider, which was examined in more detail above, the causes would now be compared with these fields of action. It is now the task of the company to compare the causes identified with these fields of action and to determine which of these fields of action would offer the greatest potential for reducing losses. From the analysis it had resulted that the fact of the missing communication to the condition of the supplied herbs leads to losses in the processes of the service provider. Thus, by improving this communication, both the field of action network cooperation and the transparency between the network partners could be addressed. In this respect, the partners involved should now jointly develop a procedure that fits their individual processes and leads to the necessary information being exchanged on a regular basis, ideally in an automated manner. Another point would be the fact that the analysis revealed a lack of process monitoring. This could be addressed under the quality management field of action. By introducing process monitoring, the overall process quality could improve and losses due to incorrect process execution could be reduced. Here, the company could support the service provider through further training and support the improvement process through its own knowledge of process monitoring.

The company should also carry out this procedure for all other processes from the analysis phase and derive measures accordingly.

At this point, the initial application of the model is complete. However, it is designed in the model that these steps are carried out recurrently in the sense of a continuous improvement process. It is therefore the task of the company to define a reasonable time horizon in which the steps are to be run through again. In doing so, it should be taken into account what time horizon the planned measures will take until they can achieve a measurable effect. Otherwise, a new analysis would identify the same causes again. A repeated execution of the process should therefore find a changed state and would thus, in addition to the further analysis of the new situation, also represent a check whether the implemented measures achieve the desired effect. In addition, the recurring examination of this logistic management model will also increase the awareness of food loss reduction management in the implementing organization.

The model does not claim to eliminate all losses that could potentially be eliminated by logistical measures. It does, however, provide implementing organizations with an action guide on how to arrive at logistical measures that can eliminate selected causes of food losses in a repeatable and structured manner.

6.6 Cooperation within East African value networks enhancing transparency

In the analysis of the fields of action to be recommended, it was shown that on almost all organizational profiles, the fields of action of transparency and network cooperation are seen in various facets as a major success factor for the reduction of food losses in East African value networks. Based on this fact, it is necessary that the organizations are aware of the different levels of transparency required as well as the dimensions an limitations of cooperation. These are described in more detail below.

As described above, an important factor in creating transparency with regard to the issue of reducing food losses is the involvement of all employee levels. Here it is particularly relevant to ensure that employees are given the opportunity to gain a clear picture of the situation by providing information. It is equally important that this information is provided in an appropriate manner according to the knowledge and skills of the respective employees. Otherwise, there is a possibility that employees will have all the necessary information at their disposal, but they will not be able to process it adequately in order to draw the right conclusions. This is particularly evident in the environment of seasonal or temporary employees. This type of employment is very common in food value networks in East Africa. As a rule, these employees have only limited knowledge of the organizational structures and little prior knowledge of the general processes of the respective actor levels, let alone the upstream and downstream levels. This means that special attention must be paid here to conveying information in a way that is appropriate for the target group. This is particularly relevant because these employees are usually involved in the direct operational handling of food and can therefore have a major influence on its condition. Within an organization, however, in addition to the provision of information to create transparency, it is also essential that all employees deal transparently with the information they gather during their work. For example, when it comes to the causes of losses, this is highly relevant. If an employee records a cause of losses but does not dare to communicate it further for fear of possible consequences, this can severely hamper the organization's efforts. Here, an important role is played by the fact that losses can be caused either by the employee's own mistakes or by the faulty behaviour of other employees. It is therefore essential for mutual transparency that an

error culture exists in the organization that welcomes the admission of errors, as these can lead to long-term improvements.

In modern organizations, such as those found in the food value networks in East Africa, the complexity of the processes and interrelationships makes it almost impossible to create holistic transparency without the use of appropriate technologies. It is therefore necessary for an organization to think about how the necessary information is to be collected and also distributed again. Each organization must identify and select suitable solutions for its own circumstances. It is crucial to choose solutions that fit into the organization's current technology and IT landscape. An introduction of a technology that goes beyond the capabilities of the actors in the organization or is unsuitable for the structures will most likely not be used for a long time after the introduction phase and will therefore not bring the added value that was hoped for. In this context, it is therefore less important to select a specific technology than to take a close look at the fit of the technology for the organization itself. In addition, a fixed data standard should be introduced within an organization if possible. When data is collected, this facilitates the consolidation of this data on the one hand and prevents the data from being distorted or misinterpreted during transformation on the other.

Related to the process level, organizations must pay attention to regular and constant data collection to create and maintain transparency. The one-time collection of process data and loss figures provides transparency about a specific point in time. However, it hardly allows statements about general correlations or conditions, as the collected data may be influenced by the situation. For this reason, continuous collection is necessary. Standardized processes for collecting the necessary process data should also be defined. Only a repetition of the surveys according to the same scheme allows also a long-term comparison of the surveys and enables to draw conclusions on the necessary actions. In addition to this fact, it is also important for holistic transparency that all processes in the organization are structured transparently. If the process steps are not clear to the respective employees due to a lack of clear definition, or if they are unable to understand them, this fact can also lead to problems in the reduction of food losses.

Once an organization has taken the internal steps to create the greatest possible transparency, it can focus on creating transparency with its direct network partners. As

described above, there are also organizations that take this step before the internal structures have been adapted accordingly. This is especially true for organizations with an area-specific intermediate profile. This can lead to success. However, it is still problematic that the organization may not have a complete overview of its own processes and may therefore pass on incorrect or incomplete information, thus possibly creating further problems. Basically, it should be noted that many organizations studied in this dissertation report that they share very limited information with network partners. In many cases, this is justified by concerns about competitive disadvantages. By keeping information secret, they want to protect themselves against network partners using the information to change business conditions in their favour and to the disadvantage of the organization providing the information. These concerns are understandable against the background of a very competitive market. It is therefore essential in this context that the organizations maintain open and continuous communication with the network partners and in this context build up a basis of trust within the framework of which long-term cooperation is made possible. Once this has been done, the organizations should agree on common data interfaces through which data can be exchanged. It is advisable to choose interfaces that do not require media discontinuity or extensive data adaptation. This ensures the accuracy and completeness of the data. In addition, regular transmission of data is easier if data interfaces are established for this purpose and new agreements do not have to be made for each new data exchange. However, it is also important to ensure that both sides have the necessary skills to use the selected interface technology and to maintain it over the long term. In this respect, it can be helpful for the network partners to support each other in building up competencies through training. Likewise, training on the correct handling of information and the appropriate communication of this information to the addressees can be a means used by network partners to promote transparency.

If there is a good level of transparency between the direct network partners, other network actors can be integrated into the activities. Here, the organizations in focus can use the good relationships with the direct network partners to approach their direct network partners together. Here, for example, the established data interfaces can be extended to other partners, and these can also be involved in joint training for the creation of transparency. To counteract the fear that providing information will have a negative

impact on one's own organization, it is advisable to set up joint working groups that span several network partners and ensure that the motives and intentions of all network partners are clearly communicated. On the one hand, this can lead to increased trust between the various actors. On the other hand, it can also lead to an intensification of relationships and thus to an overall strengthening of the market positions of the network given over competing networks.

In addition to the active players in the food value networks, the regulatory levels also have a number of options for ensuring greater transparency. In principle, this includes the possibility of issuing regulations on what information organizations must provide. This can have the advantage that organizations can no longer be at a competitive disadvantage to competitors when they provide information, since all organizations of the same rank must do so. To the same extent, however, regulations that lead to protectionist behaviour between network partners should be revised. And last but not least, regulatory levels should also financially support the introduction of technologies that increase transparency in food value networks.

As already mentioned in the model development, increasing cooperation in the network is a significant point for the large-scale reduction of food losses in East African food value networks. On this point, it should be noted that cooperation across network partners can be attributed particular importance, especially in the context of logistics. Especially through the joint planning and control of processes in the sense of logistics, processes can be better coordinated and thus causes of losses can be reduced. Many companies see greater potential in protecting their internal information than in opening up for cooperation with partners. Past experience in these companies shows that local companies were often in a weaker position of power in dependence on international companies and thus regularly had to fight for their market position. It is therefore important with regard to the utilisation of the potentials of cooperation that the organisations with a greater power position create the conditions so that the companies with a weaker position do not have to worry about their position in the network when they enter into stronger cooperation.

7 Qualitative reflections of the logistic management model for food loss reduction based on case studies from East Africa

In order to assess the applicability of the logistic management model in practice in East African food value networks, a qualitative reflection of the model was conducted using case studies. As an introduction, the approach of this qualitative reflection is described below, followed by a discussion of the results of this process.

To reflect the findings of this dissertation, case studies were conducted with companies in East Africa. For this purpose, seven interviews were conducted in Ethiopia, six interviews in Rwanda (one of them concerning Rwanda and Kenya), and five interviews in Tanzania. These took place between June and July 2022. The interviews were conducted as semi-structured interviews using a questionnaire with open and closed questions. General data about the organization was collected at the beginning. In terms of content, the readiness assessment developed as part of this dissertation (Article 2) was used as an entry point to inquire about the status quo of the respective organization. In those cases where the organizations knew their loss volumes, even if only for individual processes, these were recorded. Theoretical discussions were held with the other organizations on how the processes of loss quantification could be carried out. Afterwards, causes of losses within the organization were discussed as well as development paths regarding the management to reduce food losses in the organization were explored by means of open-ended questions. The fields of action recommended in the model were discussed with the organizations. Optimal for validation would be to accompany several organizations in the application of the logistic management model. However, this is a process that would not have been feasible in the time available. A full application of the model was not possible due to the complexity and time required for the analyses during the interviews. Therefore, interviews were conducted with the organizations to determine what development path they have gone through so far. It should be noted that especially the second step of the model, the analysis phase, could thus only be discussed theoretically. In addition to the interviews, current developments in logistics and in the study region of East Africa were included in the validation. For this purpose, current press reports and announcements from logistics companies, companies

in food value networks and locally active non-governmental organizations, as well as current scientific publications on the topic were used.

Three of the case studies are discussed in detail in the following analysis. The information from the remaining case studies has been included in the summary assessment. This is followed by a discussion of some start-ups that have emerged in the region with the aim of reducing food losses, which were identified in the case studies as well as the document research. As these were newly established for this purpose, the logistics management model is only partially applicable to them. However, they show a development that also serves to highlight the possibilities for development. The results are summarised below.

7.1 Food exporter from Kenya and Rwanda

The company considered in the following is an exporter of fruits and vegetables. The exporter works in Rwanda and Kenya. The interview was conducted with the responsible development manager for Rwanda, which is why most of the following information refers to this market. Partially, however, it was also informative about the market in Kenya.

Background and network of the company

The company decided to enter the international trade after first experiences in the national trade. For this purpose, the company participated in the international fair Fruit Logistica in Berlin. Here the first contacts with customers (importers) in Europe were established. This resulted in the five customers with whom the company cooperates today.

The company works mainly (80%) with small farmers. 2019 was started with a number of 120 in Rwanda, today there is a cooperation with 150 farmers. There is a close collaboration with these selected farmers. They support farmers by providing inputs (seeds and fertilizers), training and harvesting techniques. Here, they pay particular attention to the quality requirements, which are necessary for export to Europe. They then receive the best quality of the harvested products. The small farmers are contracted in 3-month contracts (seasonal contracts). The company is always looking for new farmers. Especially with regard to the regional location, to ensure the quality and efficiency of the products. However, great emphasis is also placed on continuing to work with existing farmers, as the company has already put energy into training these partners. The company takes responsibility for the products when they are handed over by the farmer. Thus, the

company is responsible for the transportation from the farm level to the handover to the customer (importer). From the farms, the products are transported to the company's distribution centres, where they are handled. Once orders are received usually via WhatsApp, they are then packed and airfreighted to customers in Germany, Belgium, and the UK, where they are handed over to the customer. **Figure 52** shows the schematic network of the company.

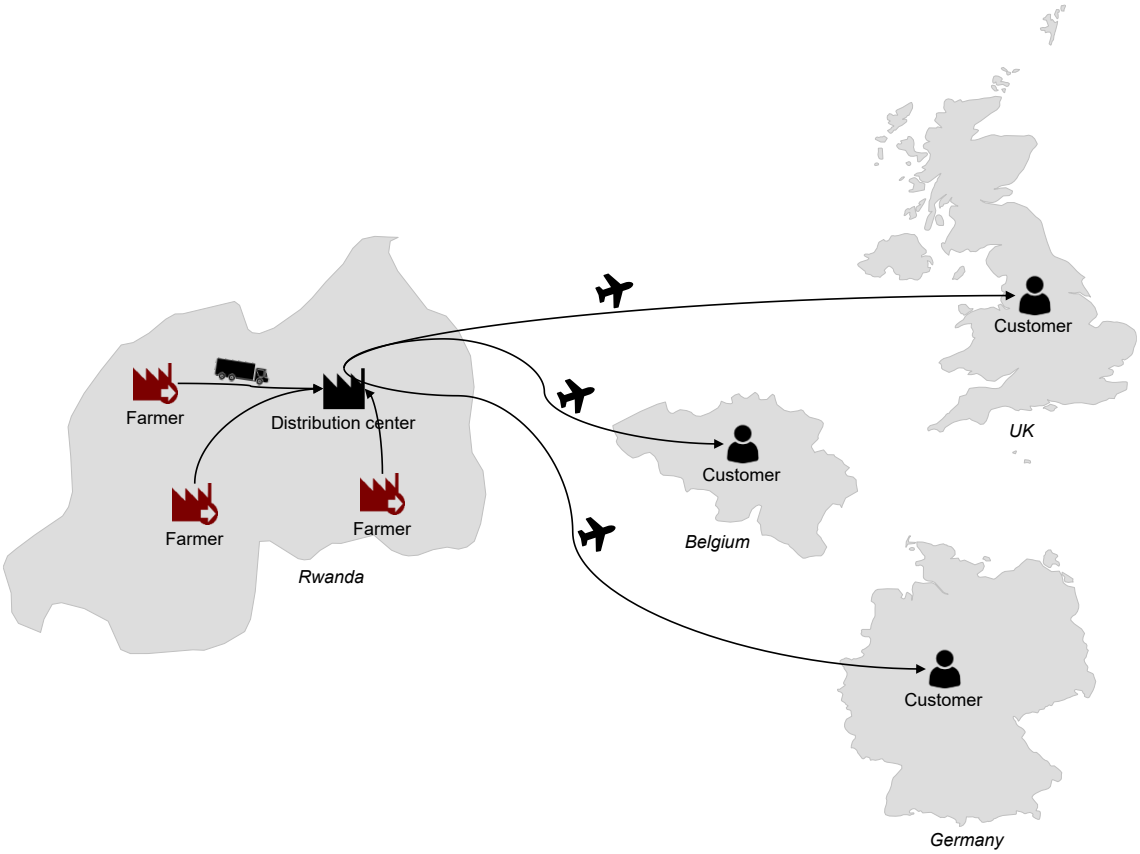

Figure 52 - Schematic network of the food exporter

Evaluation of the readiness assessment

When the readiness assessment is carried out, a scale score of 3.5 is obtained for the strategy level. This results on the statements that there is only an inaccurate feeling regarding the losses in the processes without being able to quantify them exactly. Likewise, there is only an idea from the company on how food loss reduction management should be structured in the company, but little preconceived and established thinking. However, it is stated that management clearly communicates and exemplifies that this issue is important. In some cases, targeted communication is also used to create awareness of food loss.

At the network level, a scale value of 3.8 is achieved. It is mentioned here that hardly any information provision on food losses is established between the network partners on loss figures. However, there are agreements and close cooperation on how both sides handle with losses provided by upstream network partners. Thus, there is also to some extent knowledge, about the losses occurring between the network partners. In addition, there are already measures going food losses across network boundaries. However, these are limited to the company's cooperation with the contracted farmers.

With regard to the process level, the scale value is 2.8. This is mainly due to the fact that there is basically no planned approach, or it was not possible to report on one, according to which the food loss reduction management processes are structured. However, with regard to the use of surpluses and losses that can still be used, the focus is mainly on passing them on to the local market or to food banks and the like.

At the technology level, the scale value is 1.5. It was consistently stated that no information processing technology is used for food loss reduction management and that the data is generally not recorded digitally. There is also no EDI interface to the network partners that could enable the exchange of standardized data.

The employee level is the most pronounced level at this company, with a scale value of 4.0. Although employees are motivated to address causes for losses, there is no structured incentive system that would additionally support this. However, employees are trained on a regular basis regarding proper food handling and loss prevention (although there is a systematic approach to this as described above). That information which is known to the company about losses is made fully available to the relevant employees with decision-making authority. So that they can include it in their decisions. **Figure 53** provides a visual representation of the scale values.

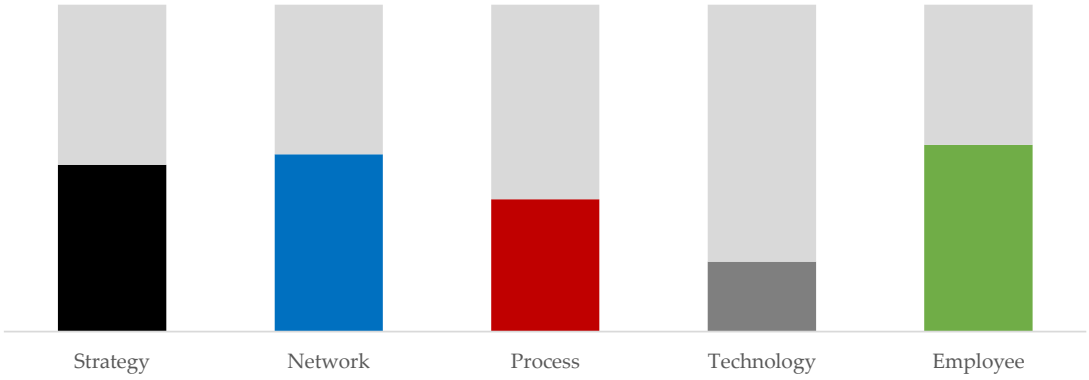

Figure 53 - Scale value of the food exporter

After comparison with the assessment scheme, the smallest difference between the values and the group of the balanced intermediate profile emerges. It should be noted that this company shows the greatest deviations from the comparison group (sample from the 3rd article) above all in the areas of employees and network. Here, the company is significantly more advanced at the employee level than the comparison group. Here, the company has already recognized the relevance of employee training for food loss reduction management and also the need to provide decision-makers with the available information. At the strategy level, the value corresponds to that of the comparison group. The other three levels are weaker than the comparison group. The greatest deviation is in the technology level. Here, the company itself also stated that the current level of use of digital technologies in particular is an important improvement factor for the further development of the company.

Past measures, experiences and planned further steps

As mentioned above, the company has so far focused strongly on the human factor in the processes. Important foundations have already been laid with regard to training employees in the handling of food and creating awareness of the relevance of reducing losses. These measures are largely in line with the recommendations proposed for the initial phase of the logistik management model. According to the recommendations of the logistic management model, this company should now, in addition to stabilizing its internal processes, in this case primarily at the process and technology level, also take a closer look at its external processes.

As already mentioned, the company sees the greatest potential for itself in the use of digital technologies. The company is therefore also aiming to implement a digitization project in the near future in order to improve internal and external communication in general, but also with a focus on food loss reduction management. According to the company, it is aiming to standardize communication processes using suitable technologies that have yet to be defined, and thus to create an exchange of information in addition to general communication that has not yet taken place between network partners. The company's plans thus also underscore the development path outlined in the stage model of the logistik management model. It should be noted here that in this case the internal and external processes are tackled simultaneously by the company and not, as envisaged in the logistic management model, internal and then external processes are worked on first. It should be noted that, due to the specific situation of the company, it may make sense to parallelize these processes. The considerations of the logistic management model provide that the focus on one activity level should avoid that too many new goals are to be achieved at the same time and thus not enough capacities can be applied for the achievement of all goals. Thus, the procedure does not completely contradict the recommendations, but is carried out differently due to the specific circumstances in which the company finds itself.

In addition to the question of the utilization of digital technologies, the company sees great potential for action in cooperation with farmers to reduce losses in the area of transport optimization and the coordination of harvesting times with collection times from the farmers. The products ripen in the hot season and are harvested accordingly. As a rule, they are harvested the day before collection and then stored overnight in the open until collection due to the lack of facilities. By the time the transport picks up the produce, the sun is already up, and it is hot. Thus, the products are exposed to the high temperature and ripen faster or may also receive direct damage due to the heat and direct sunlight. Thus, the uncoordinated processes of harvesting as well as transportation cause rentable damage, which often leads to losses. As discussed with the company, the possibility of refrigeration during this waiting period is out of the question, because the financial expenses would be out of proportion for the farmers. Likewise, there is no reliable power supply in the rural areas of cultivation. A self-sufficient supply has not yet been thought through by the company and the farmers involved. For this reason, the company's focus

in the next step is on better coordination of the processes. For example, discussions are being held with the farmers to determine the extent to which harvesting times can be shifted to cooler times of the day and the end of the harvesting period can also be synchronized with collection. Here, too, the company hopes that the digitalization project it is aiming for will make things easier, and that the farmers will also be better equipped to communicate directly.

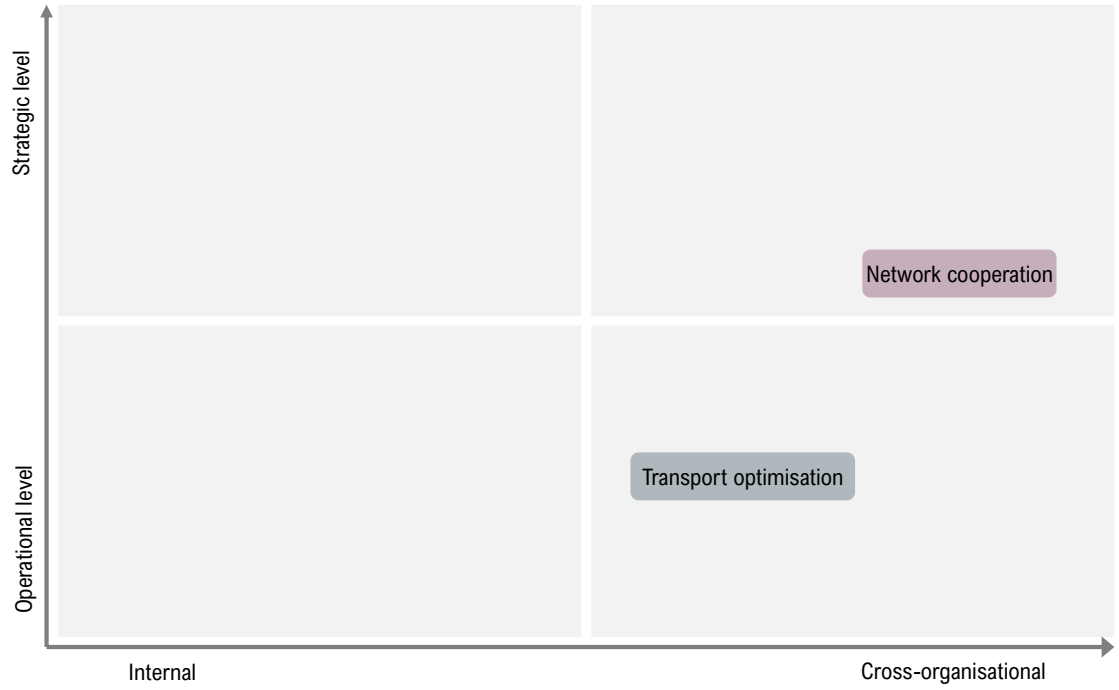

Figure 54 - Focused fields of action of the food exporter

Figure 54 shows the fields of action of food loss reduction management focused on by the company. Here, transport optimization and network cooperation are congruent with the fields of action that the comparison group indicated as the most important next steps. The company sees network cooperation in the form of digital communication as an important step. As described, this difference fits with the fact that the company is more advanced in the area of employee level than the comparison group.

7.2 Food processor from Rwanda

The following is a study of a company that operates as a food producer in Rwanda and produces flour from cassava root tubers, better known as manioc in Europe.

Background and network of the company

In Rwanda, a great amount of cassava is grown. In the past, these products were not processed commercially on a large scale in the country. Due to the special requirements of the product, many products were lost in the post-harvest processes as well as transport and storage. With this in mind, the country's government decided to establish a cassava flour production facility and a cooperative to coordinate the supply and distribution of the product. This is how the company under investigation here came into being. According to the company, this has significantly reduced losses in all cassava production in the country. Likewise, aflatoxin contamination was greatly reduced. The standardized process in the factory has improved the quality of the flour to such an extent that it now meets the standards of the international market, and the products can now also be exported.

Currently, the factory is supplied with cassava from 5 of the 30 districts in Rwanda. On the one hand, the factory has its own agents who drive through the villages in the company's own vehicles and buy suitable products directly from the farmers or local cooperatives and then bring them to the factory. Only cassava tubers harvested no more than 80 hours ago are accepted. At the same time, there are also cooperatives that independently bring their produce to the factory with their own vehicles. After delivery, the tubers are peeled by hand for quality reasons. According to the company, there are no machines available that can provide the same quality as peeling by hand. Subsequently, the peeled tubers are transported to the washing station by a conveyor belt and then washed and impurities, pieces of wood and the like are sorted out. The tubers are then cut into equal-sized pieces and then rasped by a machine. The rasped pieces are then placed in a fermentation tank where they rest for 12 to 24 hours. Two tanks are available, which are used alternately. After the resting period, the contents are pumped out of the tank and the excess water is removed. The mass is then ground and then further filtered to remove further water (about 45%). The flour is then blown through a pipe system for further drying. The drying process is completed when the flour still has a maximum water content of 10%. After drying, the flour passes a magnet to remove any metal residues in the flour.

The flour cleaned in this way is then packed in four different packaging sizes (25 kg, 10 kg, 2 kg, and 1 kg) and then stored. The packaging is done manually. Currently, about 10 tons of finished product are produced per production day. The maximum production capacity per day would be 30 tons. The current demand is enough for about two to three production days per week.

The company states that the storage period is 5 months on average. The finished product is sold through distributors on the local market and exporter on the international market. About 70% of the products are exported. The main export markets are Italy, the USA and Australia. The company states that the transport, which is by sea, from the factory to the customer takes an average of 5 months. Overall, the products have a shelf life of about two years after packaging. **Figure 55** schematically shows the company's network.

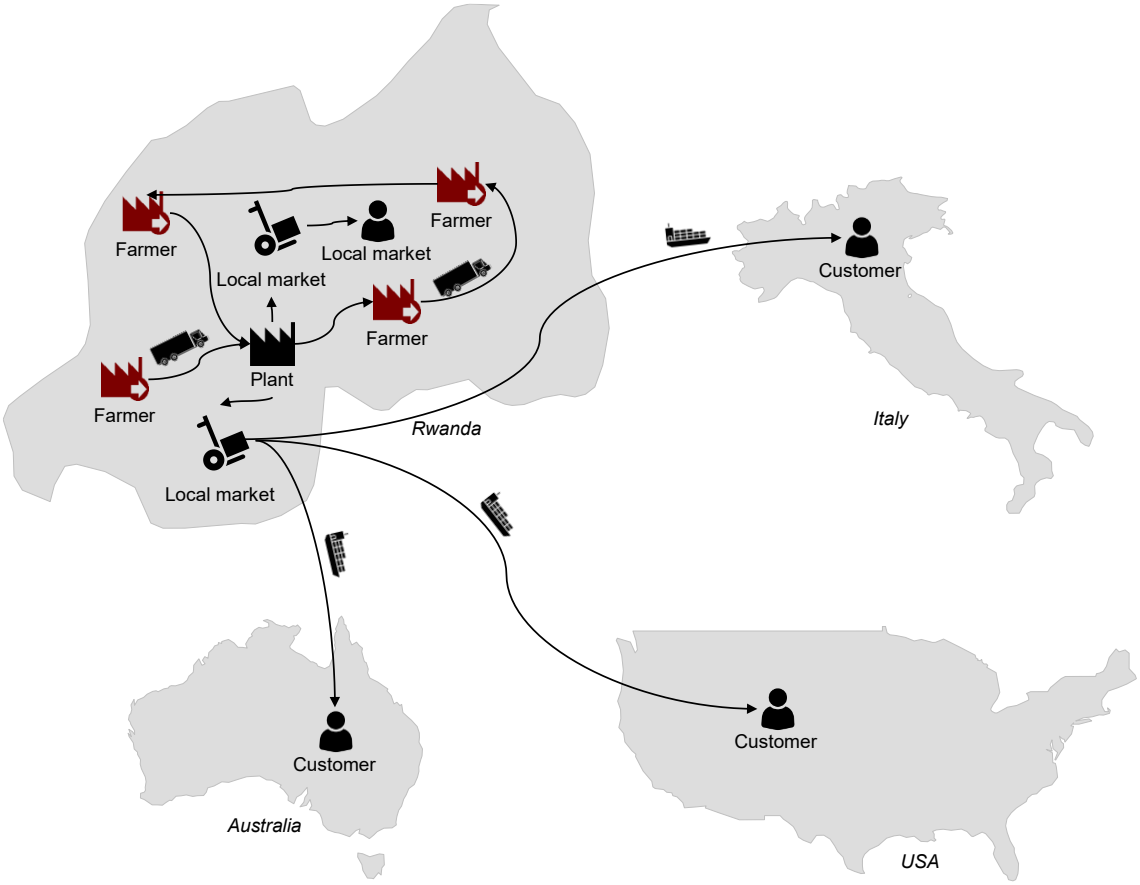

Figure 55 -Schematic network of the food processor

Evaluation of the assessment

On the strategy level, the company has a scale value of 1.4. Overall, the company stated that it does not have an overview of the losses in the processes and therefore cannot quantify them. In addition, there are no specific food loss reduction management goals and no structures established for this purpose. Furthermore, there is also no targeted communication around the awareness for the reduction of food losses in the company. However, it is stated that the management has to a certain extent recognized food loss reduction management as an important aspect and also exemplifies this.

At the network level, there is also a scale value of 1.4. The company states that it does not pass on any information on food losses to network partners, nor does it receive any information on this from network partners. There are almost no agreements with customers and suppliers on how to handle losses that a network partner receives. The company does not carry out any joint projects with network partners to reduce food losses.

At the process level, the company has a scale value of 2.3, which is the highest scale value for this company. The company does not conduct regular forecasts and does not have a clearly formulated process to collect food loss data. only in exceptional cases is documentation of causes of losses undertaken. The company uses food surpluses for energy production and stores food on a first-in, first-out basis.

On the technology level, the company achieves a scale value of 1.0. In all aspects of the technology level queried, the company indicates that these are not used. Information technologies are not used in food loss reduction management. There is no regular review of which new technologies could bring potential for progress for the company.

At the employee level, the second-best scale value is 2.0. Employees are trained in food hygiene and food loss prevention, although not on a regular basis. However, there are no incentive systems to encourage employees to make their own suggestions for improvement and reduction measures. No information on food losses is made available to employees to create transparency, and almost no information on food losses is included in the decisions of decision-makers. **Figure 56** visualizes the scale values of the company.

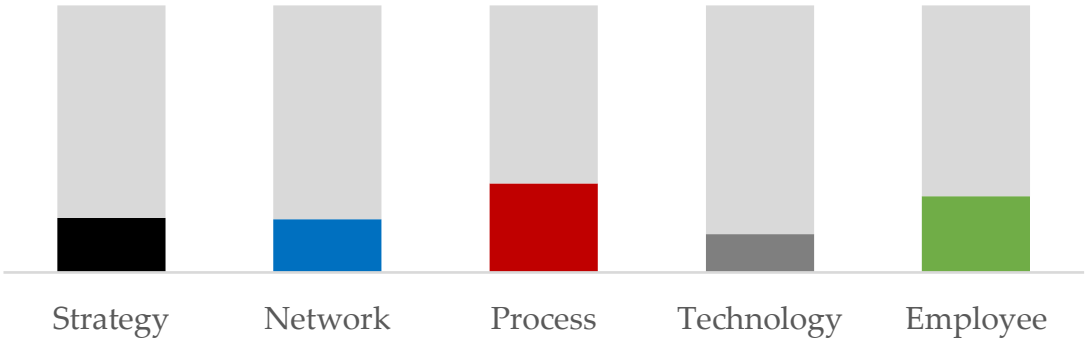

Figure 56 - Scale value of the food processor

After comparison with the comparison sample, the smallest difference results for the Beginner profile. In comparison with the comparison group, it can be seen that the company is below the values of the comparison group on average. Only in the area of employees is the company's value above that of the comparison group. The main effect here is that the company states that it trains its employees in food loss prevention, although not on a regular basis. The largest negative difference can be seen in the strategy dimension. This results primarily from the company's statement that there is no integration of food losses into the strategic elements of the company. In the other three levels, there is the same slightly negative difference to the average values of the comparison group.

Past measures, experiences and planned further steps

First of all, it should be noted that the establishment of the company can already be considered as a governmental measure against food losses. It was recognized that prompt processing and the establishment of a corresponding network in the country of production are a very effective means of combating losses of perishable goods. This shows that government agencies can use their influence positively in the sense of food loss reduction management, especially in East African countries. The government initiation not only provided sufficient financial resources for the effective construction of the factory, but also ensured that the company was equipped with the appropriate competencies to guarantee effective production. For example, the company has an advisory board made up of both experts from the field and scientists who have put their skills to work for the company. According to the company's management, this means that the company's processes are regularly reviewed, and new developments can be introduced. This

approach can generally be seen as very positive from the point of view of food loss reduction management if the relevant experts are sufficiently represented in this body and can contribute their knowledge of food loss reduction management. However, the evaluation of the self-assessment shows that the company's management has not yet recognized food loss reduction management as a core task. In the interview with the company, it became clear that the origin story alone as a food loss reduction management measure for the company is seen as sufficient activity in the area of food loss reduction management. There is currently no awareness in the company that the company processes themselves should also be examined regarding possible causes of losses. It is therefore necessary to create a corresponding awareness at all levels of the company. However, this is also in line with the recommendations of the step model of the logistic management model for companies with this profile. In addition, although the company carries out many tests regarding the quality of the products and also creates transparency on a large scale for the stakeholders involved, it cannot demonstrate transparency regarding losses. However, this would be an important point in order to be able to incorporate the corresponding information into the operational processes. It can therefore be stated that the fields of action to be recommended for this company are the same as those selected as the most relevant by the comparison group for the Beginner profile. These fields of action are shown in **Figure 57**.

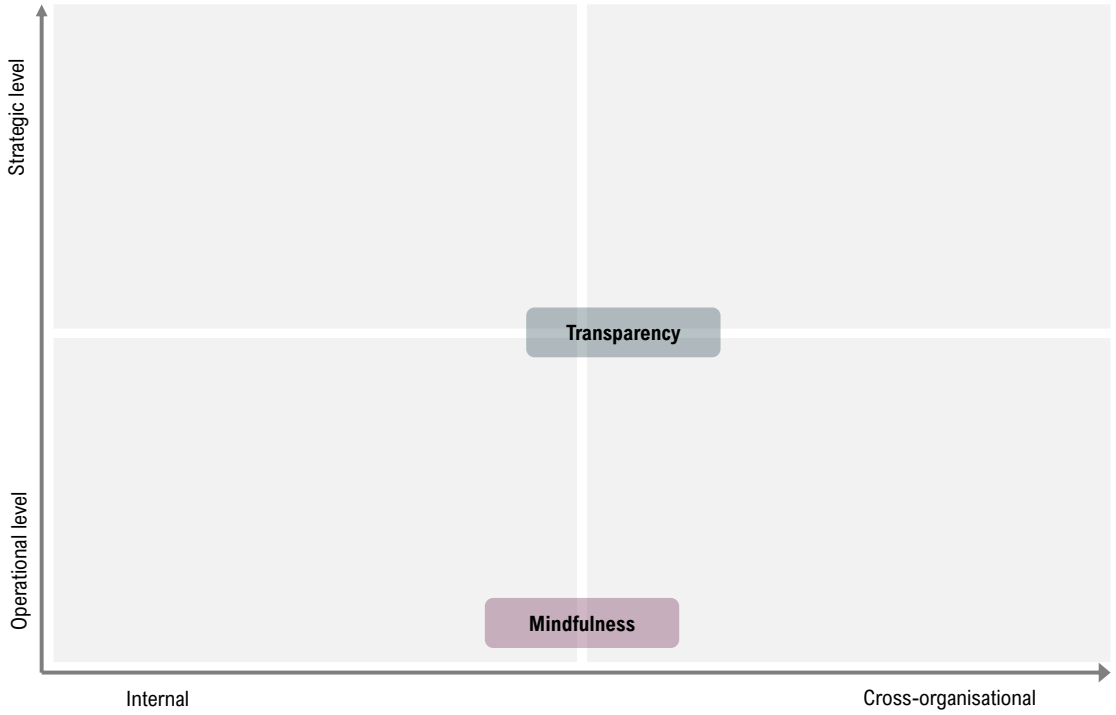

Figure 57 - Focused fields of action of the food processor

In addition to these activities that the company should undertake to advance the food loss reduction management, it should be noted that in the analysis some issues were discussed with the company, which can be identified here as causes of losses. For example, it was discussed that the process of collection by the agents is very prone to losses. When the agents collect the products from the farmers, they have only a short time to evaluate the quality. Also, large quantities are usually collected at one time. It was noted that due to a lack of cleaning facilities at the farms, soiled or even already damaged produce is often included in the transport. Due to longer transport times between the farms and the factory, it happens time and again that a rotting tuber can render an entire load unusable. In the discussion, the company mentioned various possibilities which they could generally imagine as possible solutions. First, they see better training of employees as a possibility. If they were even better trained in assessing the condition of the products, this would be a way to curb these losses. In addition, it was discussed that it would be possible to stop transporting tubers in bulk and use transport containers, which would allow better circulation of air between tubers and spread them further apart. Thus, inhibiting the risk of passing rot. In this case, however, the fact that a different form of transport would lead to the need for more trips, as fewer products could be transported at the same time, was

also discussed. In the discussion it became clear that in the short term the company does not aim to implement any of these discussed measures.

Another major challenge discussed with the company was the use of suitable technologies for the food loss reduction management. In terms of production processes, the company is characterized by a high standard of production technologies for the region. This is partly due to the fact that these are necessary to meet international quality standards for export, which was the declared goal of the government when the company was initiated. Awareness of the benefits of digital technologies, especially for use in food loss reduction management, is not yet widespread in the company and its network. It was noted during the analysis that management is aware of this factor, but without a broad awareness in the company and in the network, it has not yet been possible to make a decision for a digitization project in the cost-benefit analysis.

7.3 Logistics service provider from Ethiopia

In the following, an Ethiopian logistics service provider is analysed which, in addition to its core business, takes on other activities in the food network. This provider is predominantly active on the local market.

Background and network of the company

The company is state-owned. On the one hand, it operates as a classic logistics service provider, transporting food between farms and customers. In addition, it has the task of ensuring the supply of food to the population in general, but also in times of crisis. To this end, it builds up stocks of certain foodstuffs and then distributes them at government-set prices that are affordable for the end consumers. The company also operates sales outlets for this purpose. In total, there are about 60 sales points throughout the country, where mainly fruits are sold directly to consumers without the involvement of retailers. At the time of the analysis, mainly bananas, avocados and tomatoes were sold here.

The company employs about 400 permanent employees and about 200 temporary employees. The main focus of the company is on fresh products such as fruits and vegetables. But mainly for the purpose of crisis preparedness, the company also trades processed foods such as pasta, tomato paste, juices and especially during the period of analysis for the first-time edible oils. According to the company, this had become necessary due this massive price fluctuations of edible oils as a result of the Russian war of aggression on Ukraine, in order to make the for local population this supply still accessible. Since the company buys products directly from producers, intermediaries are illuminated from the network, minimizing costs due to many players. The suppliers are mainly commercial farms and cooperatives. Likewise, the processed food is collected directly from producers, without involving intermediaries.

Although the main focus of the company is on the local market, a small part of the products is also exported. Products that meet the high-quality standards for export are resold to exporters. Exports are mainly regionally focused and limited to neighbouring East African countries, which are supplied by land. **Figure 58** schematically shows the company's network.

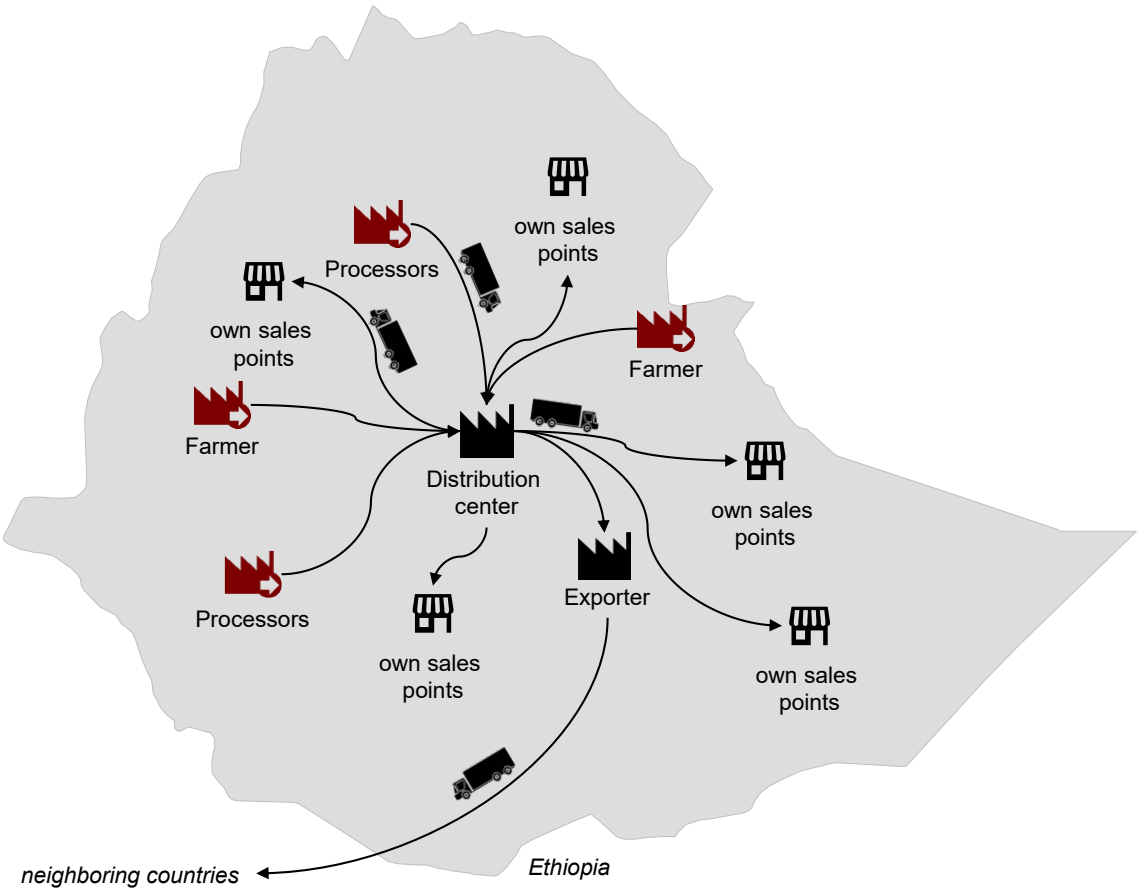

Figure 58 - Schematic network of the logistics service provider

Evaluation of the assessment

With a scale value of 6.6, the company achieves a very high value in the strategy level. The company has a clear overview and can also quantify this. The losses vary between the product groups, but the company states that on average 5% of the food is recorded as losses. Likewise, the company has a clear overview of the financial expenses that lead to food losses and can also quantify these. This fluctuates in different years, ranging from 6 to 7 million Birr in recent years. Management makes food loss reduction management a key strategic issue and supports continuous improvement. Specific targets for food loss reduction management have also been defined. The company has quality specialists who set standards to reduce food losses. The company has a weekly report on losses for each product with a description of the quantity lost. The quantities lost are recorded in weight. An organizational structure is put in place to manage food losses. Targeted communication is used top-down to increase food loss awareness and participation.

At the network level, the company achieves a scale value of 5.2. The exchange of information on food losses with network partners takes place, but not on a regular basis. However, the company has quality managers who work in the cooperatives and processing plants and therefore have direct information about conditions at their suppliers. In return, the company has agreements with both suppliers and buyers, to the greatest extent possible, on how to handle food received in each case that is to be assessed as a loss. The company does not accept inferior quality, but only after proper testing of the products. The classification of the products for export is done by the customer, so that the customer can decide whether to accept the products in the quality offered. Thus, losses during the transition between the network partners are avoided to the greatest possible extent. There have already been joint projects with network partners aimed at reducing food losses.

In the process level, the company achieves a scale value of 5.0. The organization produces sales forecasts that are regularly close to real sales. There is a documented process description that identifies known causes of losses and shows avoidance strategies. The organization has manuals on causes of losses and for handling losses. The organization has clear, formalized procedures for collecting food loss data. There is a procedure to verify the quality of the product at each stage. The organization has specific, formalized procedures for handling food losses that have occurred. The company has tried to convert the losses into fertilizer with another company, but this was not successful. Therefore, most of the losses are being disposed.

With a scale value of 4.0, the technology level is the least pronounced level for this company. Information technologies are used in the organization to collect data on food losses. Here, excel spreadsheets are mainly used. In addition, the evaluations resulting from the excel spreadsheets are used within the organization to increase transparency regarding food losses. The organization irregularly reviews new technologies for their potential to improve the organization's food loss reduction management. No electronic data interfaces are established with network partners to share food loss data. All information that the company also provides to its partners is done via Telegram and email, without using more advanced technologies, although this is desired within the company.

At the employee level, the company achieves a scale value of 5.3. The organization's employees are trained in food handling and food loss prevention. However, this takes place only once a year. The organization's employees are provided with data on the volume of food losses within the organization to create transparency. These are posted at various points on the premises. However, no checks are made to ensure that employees read this information. Employees in the organization with decision-making authority receive necessary information about food losses to support decision-making. An incentive system is used to motivate employees to make suggestions for process improvements that will reduce food losses. The company gives an annual award to one store, with one criterion being minimization of disposal. **Figure 59** visualizes the scale values of the company.

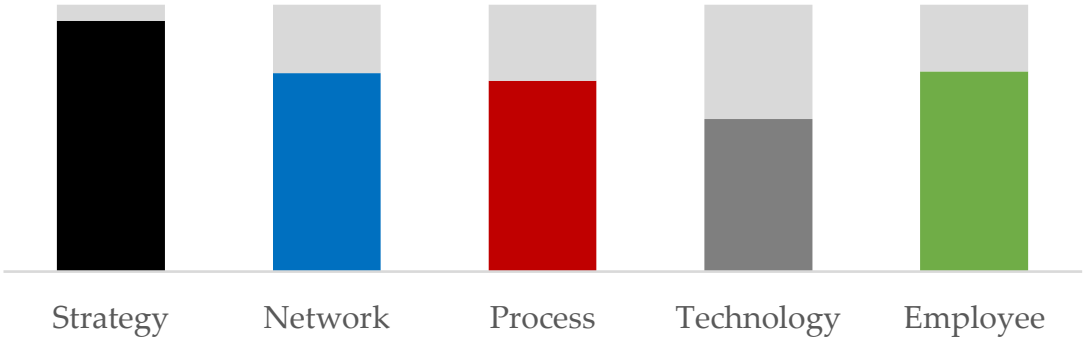

Figure 59 - Scale value of the logistics service provider

In comparison with the reference sample, the smallest deviation occurs with the values of the advanced profile. Here, the company is above the reference value of the comparison group everywhere except for the value in the technology level. The deviation in the technology level is minimally negative. The largest positive deviation is in the strategy level with 2.2 scale points. It can therefore be seen that the strategic engagement with food loss reduction management is already very advanced compared with similar companies and is even more on a par with a company with the expert profile. The company is also far away from the scale value of the reference group in the process level with a difference of 1.3 scale points. The deviation from the scale value of the expert profile is also lower than the deviation from the advanced profile. The investigation of the company also showed that, in addition to the statements made in the interviews on the

site visit, the well-defined processes described are also visibly practiced in the operational business.

Past measures, experiences and planned further steps

The evaluation of the self-assessment shows clearly that food loss reduction management is an important issue for this company. It was also found that the company has already introduced many effective measures to reduce losses. For the company's main product groups, fruits and vegetables, the estimates for the region are losses between 30% and 40%. Based on their accurately recorded loss figures, the company can show that they have already reduced them to around 5%.

According to the company's assessment, this is mainly due to the fact that the employees are very sensitized to this topic due to the company's long-standing focus on this topic. As mentioned, a training course specifically on food loss reduction management is held once a year with the employees. In addition, raising awareness of this topic is also part of the training process for temporary employees. However, regarding this aspect, the company itself has noted that they assume that long-term employees generate fewer losses than temporary employees. However, they state that due to the seasonality of the products handled, there is no way to make these employment relationships permanent. Here it was discussed whether employees could be used for other tasks in the company for the off-seasonal time. According to the assessment of the company, this would only be possible in individual cases.

Another aspect, which the company itself considers to be an important factor in reducing losses, is the continuous monitoring of processes. Here, the company has already implemented many manual controls. The company generally sees great potential for further improvements in the use of technical solutions such as sensor technology or similar. However, due to various aspects, these are not currently in the planning stage to be introduced. The company has also seen great progress in the measure of sending its own personnel to the supplier plants, who continuously monitor the processes there and pay attention to quality and product-appropriate handling. Here, agreement can be found with the recommendations of the step model of the logistic management model. Companies which, like the one studied here, are already at a very good level internally should use their competence as well as their market position to support network partners

in food loss reduction management. This example shows how this can be implemented, thereby creating added value for both network partners involved. On the one hand, the quality required by the sending company is created, thus minimizing losses in the subsequent process. On the other hand, the receiving company receives further knowledge and an automatic training of the involved employees through the continuous support, as they are regularly made aware of the relevance of food loss reduction management and the correct handling of the products.

Company representatives interviewed also noted that at the beginning of the process, it was difficult to convince all company stakeholders, including in some cases individual decision makers, to invest in improvement strategies to reduce food losses. But through continuous improvement, doubting company stakeholders were convinced of the added value of investing in food loss reduction management.

Regarding further potential for improvement, the company sees the following points in particular. The company is currently experiencing many losses in its sales outlets. According to the interviewees, this has many aspects, as customers should be offered the widest possible range of products throughout the entire opening hours. Nevertheless, great potential is seen in the use of data analysis of sales figures. The main hope here is for modern data analytics methods that can enable more accurate forecasts. Thus, more transparency is to be created in order to be able to better coordinate inventories and sales. The company also sees reduction potential in the use of cold storage and refrigerated trucks. The company has already gained initial experience in this area in the past. However, in previous projects, the maintenance of the machines was not taken into account. As a result, the refrigerated trucks could no longer be used after a certain period of time because they could no longer be brought into working condition. However, the company is currently striving to set up refrigeration plants at important storage and handling points. Here, in addition to the technical equipment, a great deal of emphasis is to be placed on the correspondingly necessary qualifications of the employees.

Overall, it can be stated that the recommending actions of the logistic management model are partially applicable for this company. The comparison group has highlighted the action areas of warehouse management and packaging management. Warehouse management through the use of cooling technologies is also targeted by the company. In

addition, as described, the further creation of transparency, especially at the points of sale, is seen as the main goal. Regarding packaging management, the company stated that it does not see any great potential for further improvements here due to the means of transport and packaging currently used. **Figure 60** shows the fields of action focused on by the company.

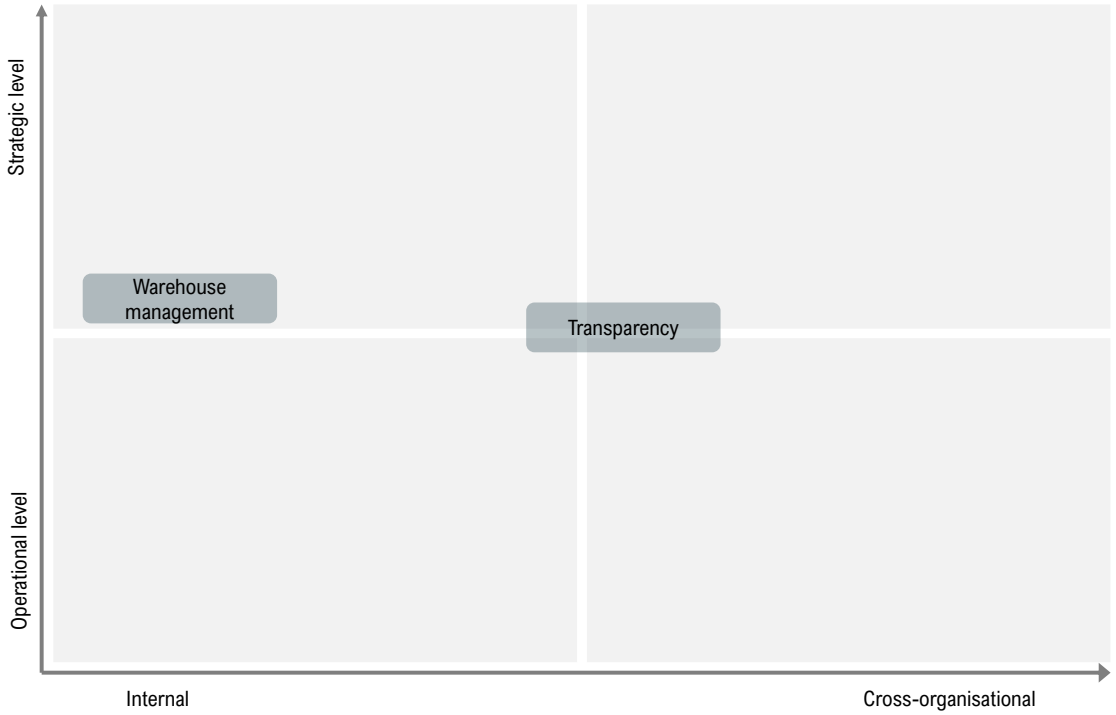

Figure 60 - Focused fields of action of the logistics service provider

7.4 Holistic sustainable start-ups in food value networks in East Africa

In addition to the classic companies described above, the following section looks at start-ups that were developed in recent years based on the idea of improving the respective local situation. Here the term holistic start-ups are used, as they do not just focus on fulfilling a specific function in the food network but have a holistic approach to shaping the entire network in mind. Sustainable start-ups here refer to the fact that the focus is not only on the financial success of the company, but on a sustainable approach that considers economic, ecological (e.g., reduction of food losses) and social (added value for the local population) aspects. These start-ups are also characterized by the fact that they introduce new technologies into the newly created structures. Due to these newly created structures, a comparison with the previous activities of the companies and the food loss reduction management Process is not possible like described above. In the following, the respective phenomenon is discussed and the added value for the objective of reducing food losses is analysed.

7.4.1 Solino Coffee

Baseline situation

Coffee is the export product of Ethiopia. It is estimated that about 15 million people in Ethiopia are directly employed in the coffee sector, which is about 28.6% of the working population. There are an estimated 800,000 smallholder farms in the large and medium production areas (woredas), growing coffee on about 520,000 ha. About 95% of the production is produced by smallholders, while 4.4% comes from state plantations and 0.6% from plantations owned by private investors.

In 2018, green coffee bean exports generated 836 million dollars, accounting for 34.6% of the country's total exports. In contrast, the export of roasted coffee accounted for only 70,000 dollars in 2018. Thus, it can be stated that Ethiopia mainly exports the raw product. The other value-added activities are carried out in the consumer countries.

The transportation of green coffee is much more challenging than the transportation of roasted coffee from a loss reduction perspective. Temperature and humidity must be controlled appropriately so that no damage, such as mould, can develop on the beans and make them unusable for further consumption. In some cases, incorrect humidity of green

coffee can result in loss of flavour and thus loss of quality and reduction of the possible profit from it. Roasted coffee, especially if it has already been packaged, is much less demanding in terms of transport conditions.

Approach

Based on this initial situation, the company Solino Coffee was founded. Its goal was to carry out the entire value network for coffee in Ethiopia. This makes Solino Coffee the first company to handle the entire value network intended for export, up to and including packaging, entirely in Ethiopia. The coffee is mainly exported to Germany. The company buys the green coffee beans directly from the coffee farmers. This bypasses intermediate stages and intermediaries, reducing complexity in the network. It also simplifies transparency in the network and makes it easier to trace the origin of the beans. Solino Coffee enables end customers to gain insight into the history and origin of the products via QR code. Solino Coffee is also committed to fair treatment and payment of all network partners. The basic philosophy of the company is to localize the added value and thus the profit in the country of origin of the coffee. In this way, the population in the country of origin should also benefit economically from their raw materials. It is assumed that up to 60% additional value can be generated in the country. **Figure 61** schematically shows the distribution of value added.

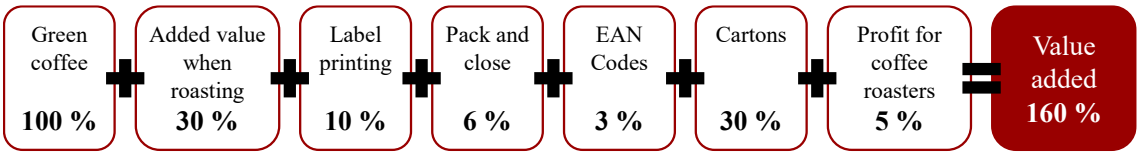

Figure 61 - Distribution of value addition in coffee value networks

Solino Coffee works directly with coffee farmers as described. The coffee beans are picked up from the coffee farmers and delivered directly to the production facility. There, the roasting, packaging, and coding are done. From there, the orders are transported in containers by train to Djibouti and from there by ship to Hamburg. In Germany, the

products are transported directly to end customers and to retailers for sale. **Figure 62** outlines this network.

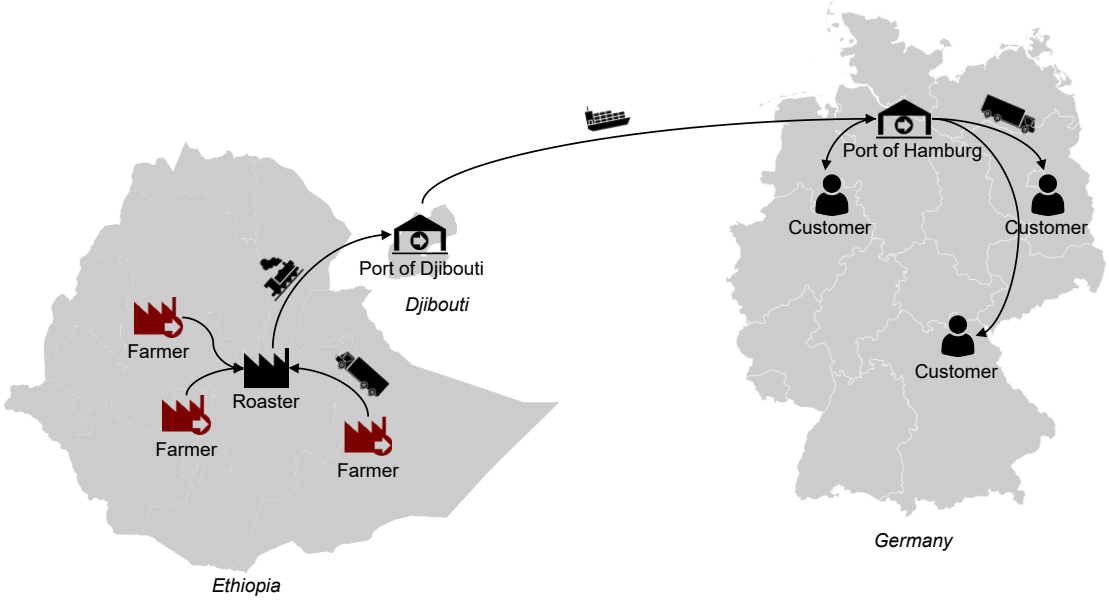

Figure 62 - Network illustration of Solino Coffee

Observation

Exact figures on the loss amounts of coffee in international transport are not published. According to the In the FAO Food Loss and Waste Database, there are no entries for African countries. Entries for South American countries ranged from 2.12% for Guatemala to 11.33% for Ecuador. Many experts say that international transport is a significant factor in losses for green coffee. So, no exact statements can be made about the reduced number of losses. However, it can be assumed that one of the largest causes of losses in the value network has been eliminated. In addition to this fact, it has been shown on a small scale that shifting value added to the country of origin creates higher skilled jobs. More than 150 new jobs have been created by this company, which are certified according to IFS. The income of these jobs is between 60 and 300 euros per month, which is double to ten times the average monthly wage of a coffee farmer in Ethiopia.

7.4.2 CASJU

Baseline situation

Cashew nuts are a relevant economic factor for Tanzania. Tanzania is one of the largest cashew nut producers in Africa. In seasons with good harvests, cashew exports generate 10 to 14% of the country's foreign exchange and produce about 20% of total African production. The harvest season is 2 to 3 months a year. Each cashew nut grows on a cashew fruit for which there is little economic use. These fruits are usually discarded, or very small quantities are processed into alcohol or used in other ways. The rest remains without use. Globally, only about 5% of the fruits are used.

Approach

CASJU has addressed this fact. After an experimental phase, a process was developed to produce a plant-based caramel from the cashew fruit. The company was built on this product. The objective of the company was on the one hand to reduce food losses and on the other hand to increase the value of the farmers' products, thus generating additional income and creating new jobs in production of the new product.

CASJU works closely with a cashew nut producer who exports the nuts to Europe. This partner collects not only the nuts but also the fruits from the farmers and brings the fruits to the processing plant. The fruits are pasteurized, and water is removed from them. The transition from farmers to local production in Tanzania is the critical process step. Within 24 hours, the fruit begins to ferment and then it cannot be used for further production. This is then transported to Denmark by airplane. Since a maximum of 400kg is usually transported, it is not possible to fill a complete container and therefore transport by ship is not suitable. In Denmark, the caramel is produced from the processed fruit and packaged. From there they are transported to customers and selected retailers. There is cooperation with an online retailer and a wholesaler, as well as an investor with cafes and stores. There are about 30 returning direct customers. **Figure 63** shows schematically the value network of CASJU.

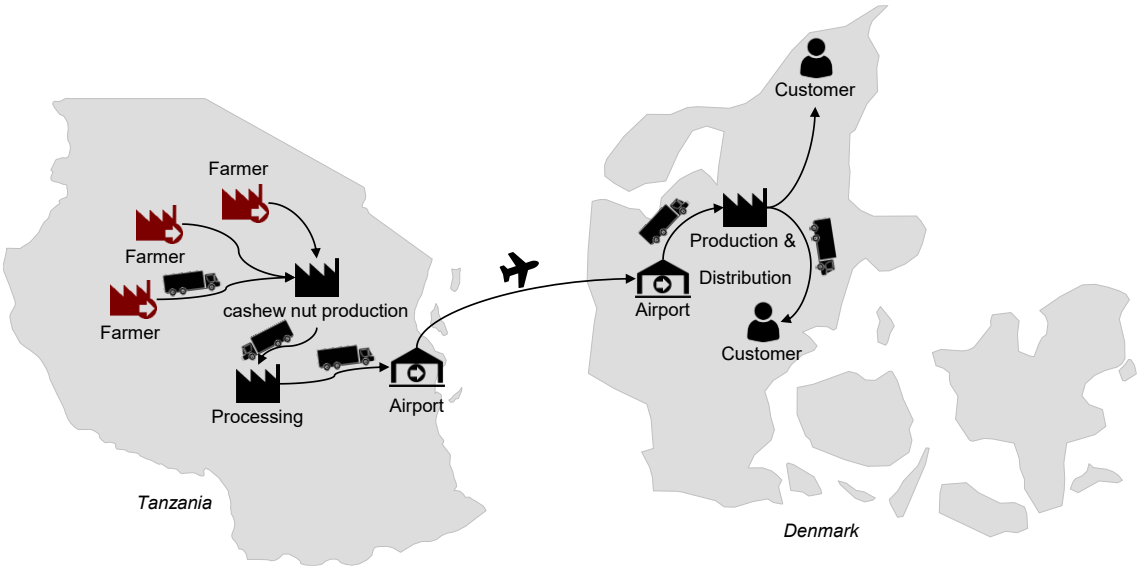

Figure 63 - Value network of CASJU

Observation

CASJU reports having created jobs locally. However, no statements are available on the number of jobs created. However, a single-digit or low double-digit number can be assumed, as the scaling of the company is at a very low level.

From the food loss reduction management point of view, the creation of the company is already a measure to reduce losses in the cashew value network. Especially in African countries, such an introduction of new utilization possibilities is of great relevance. In the conversation with CASJU, it was also discussed about the phenomenon that a lot of pumpkin seeds are produced in Tanzania. In this process, the seeds are taken out of the pumpkins and the rest of the fruits are discarded or ploughed under. This anecdotal narrative and the origin story of CASJU indicate that the one-sided utilization of locally grown crops is a problem in various value chains in East Africa. Likewise, CASJU's approach shows that there is potential here through innovative developments to use the previously unused parts of the plants for human consumption.

In addition, CASJU reports that before production began, farmers were informed about the new processes. They have been trained on how to handle the fruit so that it can arrive at further processing in the best possible quality. Despite these measures, not all parts of the delivered fruit are usable. Bruises or areas that are already fermented are removed before pasteurization. This accounts for about 20% of the delivered fruit. Furthermore,

since the fruit does not contain any internal seeds, no waste is produced. A further optimization of the delivery and the handling on the farms would therefore make sense, if the still occurring losses are to be eliminated. CASJU considers the use of better means of transport and refrigeration equipment to be the next sensible investment in reducing losses. In addition, emphasis is still placed on teaching the proper handling of the fruit. In particular, as mentioned above, the time restrictions to which the fruits are subject due to rotting must be known by all network partners involved in the process. A cooling device has already been installed in the processing plant, so that they arrived fruits can be frozen and thus the fermentation process can be stopped. Likewise, the processed fruit is frozen in this device so that it is less susceptible to loss until it is transported and on its way to Denmark.

The company shows that through the innovative idea of a person, new structures can be established, which help to reduce losses. However, problems also arise from this. The founder of the company, who is Danish herself, announced in October 2022 that the company will be closed because she will devote herself to other projects. It is thus evident that such ventures are dependent on the commitment of individuals. From the available reports it is not clear to what extent the structures built up by the company can be continued in Tanzania and whether the knowledge about the further processing to caramel was also passed on to the local employees, in order to be able to continue to operate the established value networks locally. For a sustainable value of such ventures, these steps should be taken urgently to avoid dependence on idea providers that are not locally anchored.

7.4.3 TWIGA Sun Fruits

Baseline situation

Approximately 75% of the workforce in Uganda is employed in agriculture. These jobs are largely characterized by low income and many unstable employment conditions due to the seasonality of produce. Up to 40% of agricultural products are wasted between harvest and final consonant. Due to lack of exposure and low quality of products, access to international markets is very limited. In the rural areas, where mainly the cultivation of the products takes place, is characterized by low access to clean drinking water, low

sanitary standards, as well as the processing of the products in the open air. In addition, the abdication with electricity is only about 17%.

Approach

With the foundation of TWIGA Sun Fruits, two European individuals have decided to take responsibility for the entire value network from organic farming, production and energy supply to import and distribution in Europe together with the Ugandan partners. Thereby TWIGA Sun Fruits s takes over the supply of the partners with technology for solar energy supply and drying, as well as with appropriate equipment for the production, so that together the products of the cooperative can be processed. Thus, it is the clear goal of the company to support the smallholder cooperative Kangulumira Horticulture by helping them to help themselves and furthermore to build up economic relations with them. With the support provided, the partners are to be enabled to independently manage the solar-powered manufactory and to independently engage in international trade. TWIGA Sun Fruits, as the first European customer shall open the door for this way. This will enable the cooperative to build a better life for themselves. The guiding principle of the companies, which they share with their local partners, is: "Let’s do it together for a better future".

Observation

The company's approach included the joint development of the new process and the new analogy together with the partner cooperative. As the company is still very young, the whole process is not yet operational. According to an announcement on the company's website, the first machines and equipment were sent by sea to Uganda in the summer of 2022. Accordingly, at the current stage, only observations can be made on the planned published processes. The planned process includes as its core the installation of a self-sufficient energy supply and storage. Solar thermal energy and hot water storage will be used for this purpose. In addition, photovoltaics and battery storage will be used in the system. With this combination, a solar self-sufficiency of over 95% is to be achieved. This power supply will be used for production on the one hand but will also serve as a secure source of energy for the local population. A new drying process will be established for the production. For this purpose, a cabinet dryer will be installed. This will ensure a consistently high quality of the dried fruit. All machines and equipment are made of stainless steel to guarantee the high hygienic standards that are mandatory for import to

Europe. To make the processes safer from external conditions, the planning also includes buildings in which the new process will be carried out. For this purpose, the buildings are designed according to the requirements of the processes. Likewise, the compliance with the necessary hygiene standards is already considered and the corresponding equipment is planned. After the production as well as the packaging of the products TWIGA Sun Fruits takes over the products from the cooperative and organizes the export and the sales in Europe. For this, it is stated on the website that the aim is to transport the products as sustainably as possible and for this reason orders should be collected until a complete container can be filled. It is not stated through which port the export is to be made, but due to distances to be covered it is assumed that the port in Mombasa will be used. The following **Figure 64** shows schematically the described or planned network.

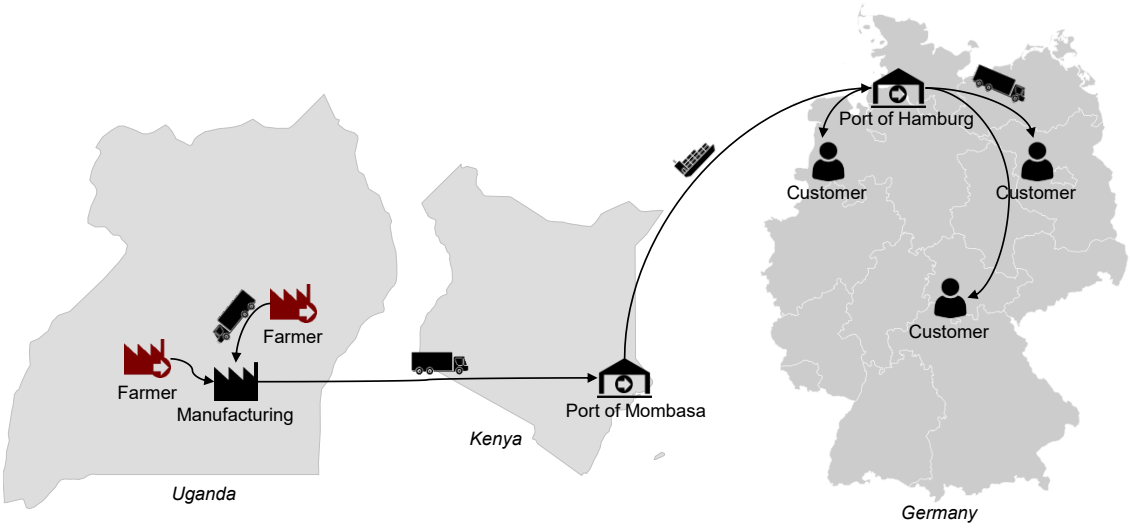

Figure 64 - Value network of TWIGA Sun Fruits

As described, the project is still under setup, so no statement can yet be made about the operational processes and their impact on the food losses that occur. Experts from the interviews conducted assess this project as promising. The approach of helping people to help themselves via a commercially oriented but non-profit company is repeatedly cited as a positive example of a new approach to international cooperation with countries in the global South. Above all, the fact that new technologies are introduced through external support, which were previously no solution alternative for the local population regarding the reduction of food losses, because the necessary financial resources were not available. In some cases, there is also a lack of knowledge about the available options.

7.5 Concluding evaluation

The analysis of the case studies has shown that the companies agree to the basic assumption of this dissertation that there is no systematic procedure for the development of logistical measures for the reduction of food in East African food value networks so far. It can also be concluded that the companies for the most part consider the model developed here to be suitable for their circumstances in an East African food value network. However, it has also been confirmed that it is necessary to develop individual approaches to solutions in each individual case for the organization or its network under consideration. It is not sufficient to formulate general solutions based only on the function of the organizations, since these also exhibit completely different conditions and circumstances in the respective networks and also in dependence on the foodstuffs handled in each case. Last but not least, it always depends on the respective history of the organization, which measures fit to the occurring causes of losses. As described in the introduction to this dissertation, there are analyses that derive general statements on causes of losses. However, the on-site investigations have shown that even for the same visible causes, many different underlying problems can be the trigger.

So, for the long-term and sustainable implementation of food loss reduction management and the elimination of the causes and underlying root problems, it is of utmost importance that the organization deals in detail with the first steps of the logistic management model. A clear picture of one's situation is the most important foundation for successful food loss reduction. This can be translated into the fact that one of the most important points for a successful food loss reduction management is the creation of transparency. Transparency here does not only refer to the knowledge of causes of losses and loss figures, but also to the structures and dynamics in one's own organization and network.

Likewise, the analysis has shown that the approach of the model presented here, to include processes as broadly as possible in the analysis, including across organizations, is also seen in practice as a promising approach. Here, too, however, the caveat is made that this requires a certain degree of maturity on the part of the individual organizations in the network to enable a successful process. This was also considered in the model presented here. In particular, the aspect that organizations can support each other through intensive collaboration and thus create added value for all network partners was repeatedly reiterated by the practice representatives interviewed.

The two aspects of transparency and network integration are discussed in more detail below.

7.5.1 Creating transparency to enable long-term reduction of food losses

According to the conclusions drawn in this work, the creation of transparency is understood to be one of the basic requirements for the successful reduction of food losses. Consequently, organizations that want to operate food loss reduction management successfully should strive for the greatest possible transparency both within their organization and within their network. This is not only about creating transparency about loss quantities and causes of losses. Regarding a holistic view of the logistics concept, it is advisable to also strive for transparency about process flows and planning data.

If an organization lacks transparency about demand planning, individual units within the organization may not consider this in their own planning, and excess inventories may result, which can quickly lead to losses in the context of perishable food. Across organizations, a lack of information transparency could lead to safety stock levels, which then lead to losses due to a lack of demand. In addition, it is important to have transparency about process changes that impact subsequent process steps. For example, a change in the warehousing strategy at a network partner can cause losses in subsequent steps due to a change in the maturity level of the products passed on. In this case, transparency must be created between the partners so that such changes are passed on or communicated directly and the subsequent steps can adapt the changes accordingly.

The section below examines how digital technologies can support transparency in this context.

7.5.1.1 Use of technology in the context of food loss reduction management in food value networks in East Africa to increase transparency

Digital technologies play an important role in creating transparency. The observations carried out have shown that information is better shared and disseminated both within organizations and across organizational boundaries when digital technologies are used.

In the context of the study area of East Africa, it was found that many small companies have a very low level of digitalization. However, these show great potential to quickly achieve improvements through the introduction of simple digitization solutions. For

example, the use of simple databases based on MS Excel can already provide an overview of loss quantities that are not visible through purely manual notation. In addition, the first simple analyses can already be made, which create further information transparency about the process data and process weak points. However, it was also found that some companies and organizations have already gained experience with the use of digital technologies and could leverage further potential in this direction through the use of more advanced applications.

In communication between network partners, digital communication tools such as WhatsApp are of particular importance. Compared to the European market, it can be seen that communication via chat apps is extremely widespread in the business environment in East Africa. This leads to the fact that in many cases digital communication channels are already very well established. These could be used even more intensively in the context of food loss reduction management to distribute relevant information to many network partners simultaneously.

It was found that there are hardly any structured and institutionalized digital structures to generate continuous information provision to create the greatest possible information transparency. From a technical point of view, the optimally transparent food value network in the context of food loss reduction management would involve all partners setting up a common digital data repository into which information relevant to all partners would be entered automatically and which would enable all partners to be provided with the information relevant to them directly, in the best case in an automated, meaningfully processed form. Such a platform would make it possible for communication to be simplified, since the network partners would no longer have to interact with each other for the sole purpose of exchanging information. Thus, more time would be available for the joint development of solution approaches.

This would require that all network partners not only have complete transparency themselves about the data relevant to all network partners. They would also have to be aware of what data is included. In addition, there would have to be a general willingness in the network to share this data. Depending on the trust relationships between the network partners, various technologies can be suitable for creating such a platform. In networks with generally good relationships and a fundamental basis of trust, classic

database systems can be used here, which then enable the precise provision of information using automated data processing, for example through the use of artificial intelligence and modern value networks analytics methods. Blockchain solutions can be suitable for networks in which there is no fundamental basis of trust between the partners, or which are characterized by frequently changing partners. Here, it is necessary for the partners to agree on an IT environment to be used jointly, into which all of them then import their data.

7.5.2 Increasing network integration for long-term reduction of food losses in East African food value networks

The various results of this work have shown that successful food loss reduction management is most efficient when there is successful collaboration between network partners. As also described earlier, one way to build better cooperation between companies can be vertical integration. Current developments in the logistics industry show a tendency for companies to increase their efforts to acquire stakes in companies that are outside their own core business. This is a contrary development to the actions of companies in recent decades, where there was potentially a trend to focus out of one's core business and divest any functional areas that lay outside of it. The period of streamlining corporate structures to core functions was accompanied by increasing globalization and digitization. The international structures were reliable and there were no reasons to doubt the reliability and regularity of the structures on a regular basis. Of course, there were occasional failures or irregularities, but these could be well controlled through classic risk management measures and active management of the value networks.

This more recent trend is, however, quite understandable in the context of current market developments. Due to the current developments because of the Covid 19 pandemic and the resulting supply interruptions, the need for restructuring and, not least, the increasingly uncertain political situation in the world as a result of the Russian war against Ukraine, the general conditions described above have changed drastically for companies. In networks where there is now a need to question the reliability of business partners, it makes sense from a sustainable business perspective to think about vertical integration. In such a situation, influence can be applied to the partner companies to enable stabilization of the entire food value network.

This makes a lot of sense from a food loss reduction management perspective in the context of logistics and the East Africa region under consideration. As has already been described, for local companies the support of global companies is partly indispensable if they want to push their reduction food loss management activities. In this context, therefore, there would be added value for both parties. Local companies, especially those with a focus on exports, would have support from international companies, would thus stabilize their distribution channels, and would receive the necessary support services for advancing food loss reduction management. The international companies would thus be able to exert greater influence on their suppliers and would in turn secure their supplier structures. The cultural differences between the individual partners must also be taken into account in this context (Pfohl and Müller 2015). In addition, it would be a win-win for these companies in terms of their social responsibility. Companies that operate under German law, and thus also have to implement the "Supply Chain Sourcing Obligations Act", would have much greater influence through such cooperation and would find it easier to obtain the necessary information to fulfil their obligations.

In this way, companies strengthen their market position by broadening their area of competence and, in the best-case scenario, support food loss activities by directly strengthening local structures in a way that is oriented toward the common good.

7.6 Discussion of the findings

In general, it was found that the companies surveyed confirmed the need for a structured process for food loss reduction management. Most of the companies have hardly gained any experience within this topic of food loss reduction management so far. The approach of the model developed here is qualitative assessed by the companies as suitable for organizations in East African food value networks.

As described, it was confirmed that the first two steps of the model are as fundamental component for a successful reduction of food losses. Especially related to the readiness assessment, it was reflected by the interviewees that this is a new way for an organization to analyse itself in the important aspects and thus get a better picture of its own starting situation. Here, strong reference was made to the fact that for this to happen, however, awareness of the relevance of food loss reduction management must be established at the important decision-making points in the organization. If this foundation is not laid, one of the most important fundamentals of this model is missing. Without management understanding the importance of food loss reduction management, it is not possible to put the entire organization on the path of a holistic focus on food loss reduction in the processes.

Regarding the development of measures, confirming statements were also found within the interviews. The interviewees confirmed that they attribute the greatest relevance to the creation of internal structures. It was also confirmed that the subsequent step is seen as joint work with the direct network partners, after which adjustments can be made across the entire network. The interviews showed that those organizations that are relatively far advanced with their internal food loss reduction management measures ensure above all that processes are transparent and employees are provided with as much information as possible to increase employee awareness of food loss reduction management. In addition, these companies strive to reduce seasonal or irregular employment and rely on extensive training measures. This underlines the recommendations made here for a basis of successful food loss reduction management. However, it was also found that local conditions partly hinder the companies' efforts to promote food loss reduction management.

For example, it was mentioned in the interviews that the company had purchased both refrigerated vehicles and the corresponding loading equipment several years ago. However, due to a lack of maintenance options, these broke down after a short time and could not be restored to a serviceable condition. From this example it can be abstracted that in the local context even the efforts of the companies alone are sometimes not sufficient to generate a sustainable solution for causes of loss, because the framework conditions are not sufficient. In the example given, with a lack of competence for maintenance in the country, one possibility would be for the government to drive activities to establish such structures, in their own country, which would not only benefit one company. This can be done, for example, through incentive schemes that attract foreign companies to the country that bring the appropriate competencies. Otherwise, these governments could provide direct funding for local companies, which would enable local companies to build up such competencies. The example given is only one aspect of missing competences, which are indirectly given for the long-term reduction of food losses. These aspects also differ from country to country and could not be fully explored in the interviews. It would therefore be advisable for the respective governments to inform themselves about the various missing competencies by involving the local companies and to initiate suitable systems accordingly.

This would also be a starting point for organizations from the development policy context. For example, the implementing organization of German development policy, the GIZ, strives to support local activities that not only create added value for one company, but also have a positive impact on many companies and the public welfare. From a holistic approach, it would therefore make sense for such organizations to approach local companies directly in order to identify the competencies they are lacking and then to work with various stakeholders to implement appropriate competency and capacity-building projects.

The interviews also indicated that the aspect of supporting network partners is of considerable relevance in practice. Several examples were described by different interview partners in which such cooperations have led to improvements in food loss reduction management activities. This was mentioned both by companies that have received such support and by companies that have supported network partners through their own activities. The second group was mainly producing or exporting local

companies working with farmers and cooperatives. In the cases described, the farmers or cooperatives were trained by employees of the companies. In most cases, the training covered the handling and communication of quality criteria and the influence of the handling of the food on quality. Such support from international companies could not be found in the interviews. This suggests that such collaborations are not widespread in the study area. Nevertheless, following the logic described above, the potential that would arise from such cooperation is quite significant. But as also described above, the added value must also be seen by the international companies. For this, the descriptive paradigm shift is necessary. Based on the observations made in the interviews, it can be concluded that there is a considerable need for action to intensify cooperation with local companies.

Regarding the direct cooperation of network partners on joint projects to reduce food losses, was generally assessed by the interview partners as meaningful and relevant. However, it was found that in the local context in cases where such cooperation could be sensible, in large parts functions are taken over by companies themselves rather than working together with network partners on joint projects. This was illustrated by an example where problems in upstream transport processes could be identified at network partners. Instead of joint activities, in this case the processes were taken over by the company concerned itself and optimized in line with its own processes. This follows the logic described above that increased network integration has potential through vertical integration of functional areas.

In the interviews, there were no companies whose activities were at a network level including indirect partners across the entire network. So, the validation of this level was used on the basis of publicly available information about locally operating companies.

In principle, there is currently no major movement toward a shift of value creation to East Africa in the food industry. This is especially true for the large internationally active companies. However, start-ups are increasingly developing that implement new production methods and technologies in these countries. In many cases, these are either founded from countries in the global North or are supported on a large scale from there. These start-ups seem to have the advantage that no established structures need to change in order to implement their objective of local near-network production. These organizations are trying to establish new network relationships to work with partners that

have the maturity to carry out further activities. Examples such as Solino Coffee in Ethiopia and Twinga Sunfruits in Uganda should be noted. These businesses have evolved from local efforts to reduce losses. Local actors have sought out supporters who have made investments to move production to where it is grown. Or there has been awareness of local potential by actors outside the local context, and contacts have been made from these considerations. Here, then, modern start-up development provided the opportunity to advance food loss reduction management by building new structures and new networks.

Overall, through the interviews and document review, it could again be established and confirmed that the corporate landscape in East Africa is very heterogeneous in food value networks. It can therefore be deduced for the study area that an intensive analysis of an organization and its circumstances must be undertaken to identify the level of engagement and the stage of food loss reduction management. In this context, the market power of the organization must also be considered regarding the recommendations for action to be derived from this. If a high internal level has already been reached, but small organizations can exert too little influence on network partners due to a lack of market position, progress in food loss reduction management can be hindered by external influences.

In summary, the following can be taken as the most relevant deductions:

- Creating transparency both within an organization and between network partners is an important factor in reducing food losses.
- The closer and better the cooperation between the network partners, the easier it is to reduce food losses within the networks.
- International companies need to intensify their collaborations with local companies in East Africa to drive a positive contribution to the reduction of food losses in network stations localized in East Africa.
- The creation of start-ups that relocate food production to food source countries in East Africa should be driven and supported by government agencies in the countries.

8 Overall summary and outlook

To be able to feed a growing world population in the long term and to achieve the global community's goal of eliminating hunger worldwide, a secure supply of food is necessary. At present, there is potentially already more than enough food to achieve this goal. So, there is currently no production problem, but a distribution problem. This is also characterized by the fact that about one third of the food produced cannot be used for human consumption but is lost before it is consumed. The introductory analysis of this dissertation has shown that this problem is related to losses in the value networks as well as to losses or wastes directly at the final consumers. However, particularly in developing countries in Sub-Saharan Africa, it was found that a very high percentage of losses can be localized within the value networks. Logistics, as an important support function in value networks, is a potential lever through which losses can be reduced. Consequently, it is a core task of sustainable, i.e., in this case resource-saving, logistics to support the reduction of these losses. Currently, activities in this context in organizations in East African food value networks are very limited and there is a lack of a systematic approach as to how logistical measures can be meaningfully selected for the objective of loss reduction.

8.1 Summary and contribution value

The main objective of this dissertation was to present a logistic management model that supports organizations in East African food value networks to develop individual logistical measures to reduce food losses. For this purpose, the following research questions were derived:

PRQ1: How can organizations operating in East Africa be enabled to independently develop solutions for eliminating causes of food losses and increase the economic viability of their companies with these measures?

PRQ2: How can a logistic management model be designed to help organizations in East African food value networks reduce food losses through logistical measures?

To answer these questions, the following three secondary research questions were addressed:

SRQ1: Which criteria are set as objective parameters when developing logistics measures against food losses?

SRQ2: How can companies be supported in determining their own level of readiness regarding the topic of food losses to be able to independently develop solutions for their own context?

SRQ3: How can organisations of food value networks be differentiated in terms of their readiness levels regarding the implementation of food loss reduction management in logistics and how can this distinction be used to derive recommendations for action for the future implementation of food loss reduction management in logistics?

In the first chapter of this dissertation, the motivation and the objective of this dissertation are presented as described. In the second chapter, the theoretical foundations of this dissertation are presented as well as an introduction to the circumstances of East African food value networks. Furthermore, the basics of the topic of food losses and food loss reduction management are presented.

The research question SRQ1 was addressed in the third chapter of this dissertation, the article "*Distinguishing Organisational Profiles of Food Loss Management in Logistics."* Based on a systematic literature analysis with 111 peer-reviewed articles and six interviews with practitioners, fields of action of food loss reduction management in the context of logistics processes were derived. Four areas and a total of thirteen fields of action were identified. This systematization of fields of action provides an important conceptual framework for the following results of this dissertation. Likewise, these results also provide a stand-alone contribution to science since they provide a new systematic basis for theoretical discussion of the reduction of food losses by compiling existing knowledge and expanding it. For practitioners seeking a methodological approach to food loss reduction, this framework can support the development of a systematic approach.

To answer the research question SRQ2, the fourth chapter of this dissertation, the article "*Development of a readiness assessment model to evaluate engagement with food loss management in logistics*", developed a concept for a readiness assessment tool through an online survey with eighty-four participants and the facts derived from it. This tool enables an assessment of an organization's previous engagement with food loss reduction.

This is the first step towards applying appropriate food loss reduction methods. This concept is an important basis for the derivations carried out later in the dissertation within the third article as well as the logistic management model in the sixed chapter of this dissertation. The second article is the first of its kind that attempts to capture the current state of an organization in food loss reduction management in order to derive actions based on that state. This provides both practitioners and scientists with the opportunity to develop systematic approaches and implement them in practice or under experimental conditions.

The fifth chapter of this dissertation, the article "*Distinguishing Organisational Profiles of Food Loss Management in Logistics*," answers the research question SRQ3 of this dissertation by applying the readiness assessment tool and derives 5 engagement profiles of organizations. This is done by applying the tool in an online survey with forty participants and analysis based on hierarchical clustering using R and R Studio. For the five organizational profiles, recommendations for further engagement with food loss reduction management were made, which are based on the results of the first article of this dissertation. This also answers the research question PRQ1 of the dissertation. These results also provide a new contribution to scholarship as this systematizes that can be used by both practitioners and scholars to make classifications.

In the sixth chapter, the previous contents of this dissertation are brought together, and the intended logistic management model is developed. This answers the research question PRQ2. The logistic management model fulfils the goal of supporting organizations in East African food value networks in reducing food losses using logistical measures. For this purpose, a readiness assessment is conducted in the initial screening stage of the model. This tool is one of the core results of this dissertation. It is because although there is a basic understanding of the problem of food losses in the organizations in East African food value networks, they are largely unable to quantify the losses in their own processes, nor do they know their own prerequisites within the organization to address this problem. The Readiness Assessment was developed to address this issue (see Chapter 4). On the one hand, it builds on the barriers that prevail in East African food value networks regarding addressing food losses. On the other hand, it is guided by the logistics dimensions of addressing trends in logistics developed by Handfield, Straube, and Pfohl 2013. Thus, a tool was developed to determine the current engagement status of an

organization in East African food value networks with food loss reduction management by querying qualitative statements in the five dimensions of strategy, people, technology, process, and network. The questionnaire for this can be found in the appendix of this dissertation. Also, as part of this dissertation, organizational profiles for engagement with food loss reduction management based on the readiness assessment were developed based on a survey of organization in East African food value networks (compare chapter 5). Within the model, an assignment to a suitable organizational profile is specified after the assessment has been applied.

On this basis, assignments are made as to which system boundaries the organization should focus on food loss reduction management. A key question is whether the organization should focus on internal processes or work together with network partners on loss reduction. According to the logic of the model, this depends on the previous engagement with the topic, which is analysed in the readiness assessment. In the second phase of the model, the analysis of the loss quantities and the causes of losses is performed. Here, the analysis is performed within the system boundaries defined in the previous step. Here, a process definition is made at the beginning. For this purpose, all physical processes through which food passes within the system boundaries are identified.

Subsequently, the input quantities of the foodstuffs in kilograms are recorded for all processes. Subsequently, the expected output quantity is recorded based on the respective processes. This is necessary because some processes result in weight changes that would otherwise be incorrectly registered as losses. These include, on the one hand, production-related weight reductions such as the removal of unforgivable components such as shells and kernels. But also, the weight losses that occurs during storage or transport due to progressive drying must be considered here. Subsequently, the losses that occur are noted. The difference between the expected output quantity and the actual output quantity are the occurring food losses. Next, the causes of the losses are analysed for all processes with a positive loss value. For this purpose, the model provides indications as to which causes could potentially exist in different processes. However, this step is highly individual and must therefore be carried out closely to the processes under investigation. Subsequently, the causes that can potentially be eliminated by logistical measures are pursued further within the framework of the model.

In order to prioritize which causes should be addressed first, the third phase of the model proposes suitable fields of action for food loss reduction management based on the assigned organizational profile from the first step, which were developed as part of this dissertation (see chapter 3). Through this mapping, organizations can develop individually appropriate logistic measures for food loss reduction based on the identified causes, the recommended action areas, and the knowledge of how the processes have been carried out so far. This model is designed as a continuous improvement process. It is therefore intended that the organizations carry out this process at regular intervals. This is, on the one hand, to ensure the sustainable effect of the measures implemented. And on the other hand, to achieve a continuous improvement of the overall situation in terms of a food logistics network in East Africa with the lowest possible losses. The model does not claim to eliminate all losses that could potentially be eliminated by logistical measures. It does, however, provide implementing organizations with an action guide on how to develop logistical measures in a repeatable and structured manner that can eliminate selected causes of food losses.

In the seventh chapter, a qualitative reflection of the model in the context of East African food value networks is undertaken. For this purpose, the possible steps of the model are applied by means of case studies. Here, the focus was mainly on the first and third phase of the model, as the implementation of the second phase was not possible due to time restrictions within the scope of the case study recording. In addition, the relations derived on the basis of the model and the preliminary results are reflected on further cases from East African food value networks. Subsequently, a discussion of the results found is provided.

8.2 Limitations of the dissertation and future research

The dissertation contributes to logistics science by presenting a logistic management model that scientifically supports organizations in East African food value networks to develop logistics measures that contribute to the reduction of food losses. However, this work is also subject to some limitations. These will be explained in more detail below. The following section will address this fact and outline the limitations of the three articles as well as the work in general. Based on this, suggestions for further research needs will be derived, which result from the limitations of this work.

For the first article, the literature search was limited to peer-reviewed journals. This may cause important aspects to be overlooked, but this risk was attempted to be reduced by including interviews with practitioners. Nevertheless, this issue could be eliminated by further research in this area, in which literature from organizations handling this topic outside the scientific context (e.g., FAO, WFP or the World Bank) is also used in addition to the publications considered here. Likewise, a larger practitioner survey could also contribute further aspects.

For both the second and third articles, it should be noted that the results were based on online surveys. This method was chosen because direct interviews with practitioners in the study area were not possible due to the Covid-19 pandemic prevalent at the time. Online surveys have the disadvantage over interviews that the researcher cannot control the respondent's understanding of the questions, for example, by asking questions back if the researcher realizes that the respondent interpreted a question differently than it was intended. It is therefore possible that in the online surveys conducted, respondents interpreted questions differently than they were intended and might therefore have provided incorrect information. To keep this risk as low as possible, the questions were developed and tested according to scientific standards. However, this problem with the method cannot be ruled out. Hence the research questions worked on here could be examined again by in-person interviews in an extended group of participants, in order to compare whether the results would change with the application of another method. In addition, the number of participants in both surveys is relatively small. Thus, the transferability of the results may be limited. Due to the fact that the methods used for the evaluation can reliably work with this number of observations, the results of the methods were nevertheless trusted and further used.

In general, it should be noted that the results of this work are designed for the study area of East Africa and were generated by data collection in this study area. Likewise, in the development of the logistic management model, the special framework conditions of the region and the local conditions were considered to a large extent. Consequently, the results of this dissertation should only be applied to food value networks in East Africa, subject to the limitations already described. Whether a transfer to other study areas or the general food loss reduction management is possible independent of the geographical application area should be part of further research. The present work can be used as a blueprint for generating such research in other study areas. Likewise, the results can be applied in different areas and the resulting findings can be examined for plausibility.

This dissertation has set itself the clear goal of defining a process of how concretely organizations can be supported in the implementation of individual food loss reduction management and development of logistical measures to reduce food losses in East African food value networks. The fact that loss figures can be recorded in order to quantify the success of the process has been addressed. It was not the focus of this work to validate the success of the model based on quantifications within the case studies. This was mainly for one important reason. The current data situation on food losses is, as described in detail in the introduction of this dissertation, incomplete and largely based on estimates. Creating a transparent and realistic picture here should, in principle, be the first step in approaching this problem. However, this was beyond the possibilities available within the scope of this work. In order to get a broad picture of the real extent of this problem, it is necessary to make an effort of all actors in the local, but also international logistics networks of this world. There are first movements here, but there is still a long way to go to get a large-scale transparent picture of the extent of the problem.

The aim of this work was thus to make a scientific contribution to the international goal of reducing food losses. Specifically, the goal was to provide support to organizations in East African food value networks to develop logistical measures to reduce food losses. This is in the context of developing countries that have embarked on the development path towards building self-reliant economic structures. Thus, this work has advanced a new step in modern logistics science. It deals in a new way with the combination of logistics perspective and food loss reduction in East Africa. It links these aspects in a

scientific context to create a basis on which further scientists and practitioners can start to support sustainable development in this region.

9 References

A. Rijpkema, Willem; Rossi, Roberto; van der G.A.J. Vorst, Jack (2014): Effective sourcing strategies for perishable product supply chains. In *Int Jnl Phys Dist & Log Manage* 44 (6), pp. 494–510. DOI: 10.1108/IJPDLM-01-2013-0013.

Addisu Damtie, Yilebes (2015): The Effect of Shocks: An Empirical Analysis of Ethiopia. In *: Interdiscip. Descr. Complex Syst.* 13 (3), pp. 450–460. DOI: 10.7906/indecs.13.3.9.

Afrika-Verein (2018): Afrikapolitische Forderungen für die 19. Legislaturperiode. Edited by Afrika-Verein der deutschen Wirtschaft e.V. Afrika-Verein der deutschen Wirtschaft e.V. Available online at http://www.afrikaverein.de/uploads/media/PP_Afrikapolitik_2018_April_final_01.pdf, checked on 6/12/2018.

Aggarwal, Shikha; Srivastava, Manoj Kumar (2016): Towards a grounded view of collaboration in Indian agri-food supply chains. In *British Food Journal* 118 (5), pp. 1085–1106. DOI: 10.1108/BFJ-08-2015-0274.

Ahumada, Omar; Villalobos, J. Rene (2011): A tactical model for planning the production and distribution of fresh produce. In *Ann Oper Res* 190 (1), pp. 339–358. DOI: 10.1007/s10479-009-0614-4.

Akkas, Arzum; Gaur, Vishal; Simchi-Levi, David (2018): Drivers of Product Expiration in Consumer Packaged Goods Retailing. In *Management Science*. DOI: 10.1287/mnsc.2018.3051.

Alamar, Maria del Carmen; Falagán, Natalia; Aktas, Emel; Terry, Leon A. (2018): Minimising food waste: a call for multidisciplinary research. In *Journal of the Science of Food and Agriculture* 98 (1), pp. 8–11. DOI: 10.1002/jsfa.8708.

Alarcon, Pablo; Fèvre, Eric M.; Murungi, Maurice K.; Muinde, Patrick; Akoko, James; Dominguez-Salas, Paula et al. (2017): Mapping of beef, sheep and goat food systems in Nairobi - A framework for policy making and the identification of structural

vulnerabilities and deficiencies. In *Agricultural Systems* 152, pp. 1–17. DOI: 10.1016/j.agsy.2016.12.005.

Alberti, Fernando G.; Belfanti, Federica (2019): Creating shared value and clusters. In *Competitiveness Review* 29 (1), pp. 39–60. DOI: 10.1108/CR-01-2017-0008.

Aldaco, R.; Hoehn, D.; Laso, J.; Margallo, M.; Ruiz-Salmón, J.; Cristobal, J. et al. (2020): Food waste management during the COVID-19 outbreak: a holistic climate, economic and nutritional approach. In *The Science of the total environment* 742, p. 140524. DOI: 10.1016/j.scitotenv.2020.140524.

Allen, Stuart J.; Schuster, Edmund W. (2004): Controlling the Risk for an Agricultural Harvest. In *M&SOM* 6 (3), pp. 225–236. DOI: 10.1287/msom.1040.0035.

Al-Madbouh, Suha; Al-Khatib, Issam A.; Al-Sari, Majed I.; Salahat, Jumana I.; Jararaa, Baraa Y. A.; Ribbe, Lars (2019): Socioeconomic, agricultural, and individual factors influencing farmers' perceptions and willingness of compost production and use: an evidence from Wadi al-Far'a Watershed-Palestine. In *Environmental Monitoring and Assessment* 191 (4), p. 209. DOI: 10.1007/s10661-019-7350-2.

Antman, Elliott M.; Appel, Lawrence J.; Balentine, Douglas; Johnson, Rachel K.; Steffen, Lyn M.; Miller, Emily Ann et al. (2014): Stakeholder discussion to reduce population-wide sodium intake and decrease sodium in the food supply: a conference report from the American Heart Association Sodium Conference 2013 Planning Group. In *Circulation* 129 (25), e660-79. DOI: 10.1161/CIR.0000000000000051.

Arias Bustos, Carolina; Moors, Ellen H.M. (2018): Reducing post-harvest food losses through innovative collaboration: Insights from the Colombian and Mexican avocado supply chains. In *Journal of Cleaner Production* 199, pp. 1020–1034. DOI: 10.1016/j.jclepro.2018.06.187.

Aschemann-Witzel, Jessica; Hooge, Ilona E. de; Rohm, Harald; Normann, Anne; Bossle, Marilia Bonzanini; Grønhøj, Alice; Oostindjer, Marije (2017): Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste – A multiple case study. In *Journal of Cleaner Production* 155, pp. 33–45. DOI: 10.1016/j.jclepro.2016.11.173.

Astill, Jake; Dara, Rozita A.; Campbell, Malcolm; Farber, Jeffrey M.; Fraser, Evan D.G.; Sharif, Shayan; Yada, Rickey Y. (2019): Transparency in food supply chains: A review of enabling technology solutions. In *Trends in Food Science & Technology* 91, pp. 240–247. DOI: 10.1016/j.tifs.2019.07.024.

Atkins, Ryan; Deranek, Kimberly; Nonet, Guénola (2018): Supply chain food waste reduction and the triple bottom line. In *Social Business* 8 (2), pp. 121–144. DOI: 10.1362/204440818X15208755029645.

Azuara, Guillermo; Luis Tornos, José; Luis Salazar, José (2012): Improving RFID traceability systems with verifiable quality. In *Industr Mngmnt & Data Systems* 112 (3), pp. 340–359. DOI: 10.1108/02635571211210022.

Baesens, Bart (2014): Analytics in a Big Data World. The Essential Guide to Data Science and its Applications. Hoboken: Wiley (Wiley and SAS Business Series).

Bakhtavar, Muhammad A.; Afzal, Irfan; Basra, Shahzad M. A.; Wahid, Abdul (2019): Implementing the 'dry chain' during storage reduces losses and maintains quality of maize grain. In *Food Sec.* 11 (2), pp. 345–357. DOI: 10.1007/s12571-019-00905-2.

Bantayehu, Muluken; Alemayehu, Melkamu; Abera, Mirkuz; Bizuayehu, Solomon (2017): Postharvest Losses Assessment of Tropical Fruits in the Market Chain of North Western Ethiopia. In *Food Science and Quality Management*, Article Vol.66, pp. 13–24.

Baumgarten, H.; Keßler, Martin; Schwarz, Jennifer Rebecca (2010): Jenseits der kommerziellen Logistik. die humanitäre Hilfe logistisch unterstützen. In Robert Schönberger (Ed.): Dimensionen der Logistik. Funktionen, Institutionen und Handlungsebenen. 1. Aufl. Wiesbaden: Gabler (Gabler Research), pp. 451–475.

Baumgarten, Helmut; Blome, Hendrik (2014): Bessere Hilfseinsätze. In *Entwicklung und Zusammenarbeit* 2014, 2014 (11), pp. 423–433. Available online at https://www.dandc.eu/de/article/helmut-baumgarten-und-hendrik-blome-wie-die-logistik-bei-hilfseinsaetzen-krisenregionen, checked on 6/13/2018.

Baumgarten, Helmut; Wiendahl, Hans-Peter; Zentes, Joachim (Eds.) (2002): Logistik-Management. Strategien - Konzepte - Praxisbeispiele. Berlin, Heidelberg, s.l.:

Springer Berlin Heidelberg. Available online at http://dx.doi.org/10.1007/978-3-662-08411-3.

Bijman, Jos; Omta, S. W. F.; Trienekens, J. H.; Wijnands, J. H. M.; Wubben, E. F. M. (Eds.) (2006): International agri-food chains and network. Management and organization. International conference on management in agri-food chains and network. Wageningen: Acad. Publishers.

Blome, Hendrik (2016): Logistische Optionen für eine nachhaltige Versorgung von Subsahara-Afrika. ein Beitrag zur Humanitären Logistik. With assistance of Technische Universität Berlin, Hans Hirth. Berlin.

BMEL (2020): Ernährung sichern – Wachstum fördern. Das Engagement des BMEL für eine moderne, nachhaltige Land-, Ernährungs- und Forstwirtschaft in Afrika. With assistance of Referat 623 BMEL. Edited by Bundesministerium für Ernährung und Landwirtschaft. Bundesministerium für Ernährung und Landwirtschaft. Berlin. Available online at https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/afrika-konzept.pdf?__blob=publicationFile&v=10, checked on 1/7/2023.

BMWi (2017): Pro! Afrika. Perspektiven fördern, Chancen nutzen, Wirtschaft stärken. Bundesministerium für Wirtschaft und Energie.

Bonadonna, Alessandro; Matozzo, Andrea; Giachino, Chiara; Peira, Giovanni (2019): Farmer behavior and perception regarding food waste and unsold food. In *British Food Journal* 121 (1), pp. 89–103. DOI: 10.1108/BFJ-12-2017-0727.

Borit, Melania; Santos, Jorge (2015): Getting traceability right, from fish to advanced bio-technological products: a review of legislation. In *Journal of Cleaner Production* 104, pp. 13–22. DOI: 10.1016/j.jclepro.2015.05.003.

Borrello, Massimiliano; Caracciolo, Francesco; Lombardi, Alessia; Pascucci, Stefano; Cembalo, Luigi (2017): Consumers' Perspective on Circular Economy Strategy for Reducing Food Waste. In *Sustainability* 9 (1), p. 141. DOI: 10.3390/su9010141.

Bortolini, Marco; Faccio, Maurizio; Ferrari, Emilio; Gamberi, Mauro; Pilati, Francesco (2016): Fresh food sustainable distribution: cost, delivery time and carbon footprint three-objective optimization. In *Journal of Food Engineering* 174, pp. 56–67. DOI: 10.1016/j.jfoodeng.2015.11.014.

Brewster, Christopher; Roussaki, Ioanna; Kalatzis, Nikos; Doolin, Kevin; Ellis, Keith (2017): IoT in Agriculture: Designing a Europe-Wide Large-Scale Pilot. In *IEEE Commun. Mag.* 55 (9), pp. 26–33. DOI: 10.1109/MCOM.2017.1600528.

Brunelle, Thierry; Coat, Mathilde; Viguié, Vincent (2017): Demand-side mitigation options of the agricultural sector: potential, barriers and ways forward. In *Ocl-Oilseeds and Fats Crops and Lipids* 24 (1), D104. DOI: 10.1051/ocl/2016051.

Brüntrup, Michael; Schwarz, Fabian; Absmayr, Thomas; Dylla, Jonas; Eckhard, Franziska; Remke, Kerstin; Sternisko, Konrad (2018): Nucleus-outgrower schemes as an alternative to traditional smallholder agriculture in Tanzania – strengths, weaknesses and policy requirements. In *Food Sec.* 10 (4), pp. 807–826. DOI: 10.1007/s12571-018-0797-0.

Bücking, Mark; Hengse, Andreas (2018): Fraunhofer Allianz »Food Chain management«. Edited by Frauenhofer Food Chain. Fraunhofer-Institut für Molekularbiologieund Angewandte Oekologie IME. Available online at https://www.fcm.fraunhofer.de/content/dam/fcm/de/documents/Broschuere_FCM/Fraunhofer-AllianzFCM-A4.pdf, checked on 2/9/2020.

BVL (2019): Logistik Definition. Erklärung und verschiedene Ansätze. Available online at https://www.bvl.de/service/zahlen-daten-fakten/logistikdefinitionen, updated on 7/23/2019, checked on 11/12/2019.

CAIXETA-FILHO, JOSÉ VICENTE (1999): Losses in the Transportation of Fruits and Vegetables: A Brazilian Case Study. In *International Journal of Logistics-Research and Applications* 2 (3), pp. 325–341. DOI: 10.1080/13675569908901588.

Chaudhuri, Atanu; Dukovska-Popovska, Iskra; Subramanian, Nachiappan; Chan, Hing Kai; Bai, Ruibin (2018): Decision-making in cold chain logistics using data

analytics: a literature review. In *International Journal of Logistics Management* 29 (3), pp. 839–861. DOI: 10.1108/IJLM-03-2017-0059.

Chelbi, A.; Aït-Kadi, D.; Radhoui, M. (2008): An integrated production and maintenance model for one failure prone machine-finite capacity buffer system for perishable products with constant demand. In *International Journal of Production Research* 46 (19), pp. 5427–5440. DOI: 10.1080/00207540802273660.

Chen, Mu-Chen; Lu, Chung-Cheng; Liu, Yi-Ching (2018): Optimal consolidation of fresh agricultural products in a multi-temperature joint distribution system. In *International Journal of Logistics Management* 29 (3), pp. 887–901. DOI: 10.1108/IJLM-01-2017-0021.

Chimphango, Annie F.A.; Görgens, Johann F. (2015): Postharvest technology for advancing sustainable bioenergy production for food processing. In *British Food Journal* 117 (12), pp. 2850–2862. DOI: 10.1108/BFJ-07-2014-0259.

Chuang, Cheng-Hsin; Lee, Da-Huei; Chang, Wan-Jung; Weng, Wan-Ching; Shaikh, Muhammad Omar; Huang, Chung-Lin (2017): Real-Time Monitoring via Patch-Type Piezoelectric Force Sensors for Internet of Things Based Logistics. In *Ieee Sensors Journal* 17 (8), pp. 2498–2506. DOI: 10.1109/JSEN.2017.2665653.

COLGAN, CONOR; ADAM, GEORGE; TOPOLANSKY, FEDERICO (2013): Why try Lean? A Northumbrian Farm case study. In *Int J Agr Manage* 2 (3), p. 170. DOI: 10.5836/ijam/2013-03-06.

Cristóbal, Jorge; Castellani, Valentina; Manfredi, Simone; Sala, Serenella (2018): Prioritizing and optimizing sustainable measures for food waste prevention and management. In *Waste management (New York, N.Y.)* 72, pp. 3–16. DOI: 10.1016/j.wasman.2017.11.007.

Dani, Samir (2015): Food supply chain management and logistics. From farm to fork. London, Philadelphia: Kogan Page.

Deloitte (2015): Reducing Food Loss Reducing Food Loss Along African Agricultural Value Chains. Edited by Deloitte. Available online at

https://www2.deloitte.com/content/dam/Deloitte/za/Documents/consumer-business/ZA_FL1_ReducingFoodLossAlongAfricanAgriculturalValueChains.pdf, checked on 11/9/2022.

Despoudi, Stella; Papaioannou, Grammatoula; Saridakis, George; Dani, Samir (2018): Does collaboration pay in agricultural supply chain? An empirical approach. In *International Journal of Production Research* 56 (13), pp. 4396–4417. DOI: 10.1080/00207543.2018.1440654.

Devin, Bree; Richards, Carol (2018): Food Waste, Power, and Corporate Social Responsibility in the Australian Food Supply Chain. In *J Bus Ethics* 150 (1), pp. 199–210. DOI: 10.1007/s10551-016-3181-z.

Durach, Christian F. (2015): A theoretical and practical contribution to supply chain robustness. Berlin: Universitätsverlag der TU Berlin (Schriftenreihe Logistik der Technischen Universität Berlin, 33).

EMC Education Services (2015): Data science and big data analytics. Discovering, analyzing, visualizing and presenting data. With assistance of Beibei Yang, David Dietrich, Robert Heller. Indianpolis, IN: John Wiley & Sons. Available online at https://onlinelibrary.wiley.com/doi/book/10.1002/9781119183686.

English, Alicia (Ed.) (2019): The state of food and agriculture. Rome, Italy: Food and Agriculture Organization of the United Nations (State of the world).

European Parliament (2002): Verordnung (EG) Nr. 178/2002 des Europäischen Parlaments und des Rates vom 28. Januar 2002 zur Festlegung der allgemeinen Grundsätze und Anforderungen des Lebensmittelrechts, zur Errichtung der Europäischen Behörde für Lebensmittelsicherheit und zur Festlegung von Verfahren zur Lebensmittelsicherheit. Verordnung (EG) Nr. 178/2002. Source: http://www.bfr.bund.de/cm/343/2002_178_de_efsa.pdf (Zugriff: 04. November 2017).

Facchini, Francesco; Pascale, Gianluigi de; Faccilongo, Nicola (2018): Pallet Picking Strategy in Food Collecting Center. In *Applied Sciences-Basel* 8 (9), p. 1503. DOI: 10.3390/app8091503.

Fang Du, Xiao; Leung, Stephen C.H.; Long Zhang, Jin; Lai, K. K. (2009): Procurement of agricultural products using the CPFR approach. In *Supply Chain Management-An International Journal* 14 (4), pp. 253–258. DOI: 10.1108/13598540910970081.

FAO (2013): The state of food insecurity in the world 2013. The multiple dimensions of food security. Rome: Food and Agriculture Organization of the United Nations. Available online at http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=682110.

FAO (2017a): Food outlook. Biannual report on global food markets, November 2017. Rome, Italy: FAO Trade and Markets Division.

FAO (2017b): The State of Food security and nutrition in the World. Building resilience for food and food security. Rome: FAO (The state of food security and nutrition in the world, 2017).

FAO (2021): Guidance on core indicators for agrifood systems – Measuring the private sector's contribution to the Sustainable Development Goals. Rome: FAO. Available online at https://www.fao.org/3/cb6526en/cb6526en.pdf, checked on 2/22/2022.

Faour-Klingbeil, Dima; Murtada, Muhammad; Kuri, Victor; Todd, Ewen C.D. (2016): Understanding the routes of contamination of ready-to-eat vegetables in the Middle East. In *Food Control* 62, pp. 125–133. DOI: 10.1016/j.foodcont.2015.10.024.

Federal Democratic Republic of Ethiopia (2016): Growth and Transformation Plan II (GTP II) (2015/16-2019/20). Volume I: Main Text. Edited by National Planning Commission. Addis Ababa. Available online at https://europa.eu/capacity4dev/resilience_ethiopia/document/growth-and-transformation-plan-ii-gtp-ii-201516-201920, checked on 7/16/2018.

Food and Agriculture Organization of the United Nations (2022): Food Loss and Waste Database. Edited by Food and Agriculture Organization of the United Nations. Available online at https://www.fao.org/platform-food-loss-waste/flw-data/en/, checked on 11/23/2022.

Fu, Hongyong; Teo, Kok Loy; Li, Yujie; Wang, Lei (2018): Weather Risk–Reward Contract for Sustainable Agri-Food Supply Chain with Loss-Averse Farmer. In *Sustainability* 10 (12), p. 4540. DOI: 10.3390/su10124540.

Garbaba, Chemeda Abedeta; Denboba, Lemlem Gurmu; Mendesil, Esayas; Ocho, Fikre Lemessa; Hensel, Oliver (2018): Actors' post-harvest maize handling practices and allied mycoflora epidemiology in southwestern Ethiopia: Potential for mycotoxin-producing fungi management. 237-248 Pages / Journal of Applied Botany and Food Quality, Vol 91 (2018): Journal of Applied Botany and Food Quality / Journal of Applied Botany and Food Quality, Vol 91 (2018): Journal of Applied Botany and Food Quality. DOI: 10.5073/JABFQ.2018.091.032.

Garske, Beatrice; Heyl, Katharine; Ekardt, Felix; Weber, Lea; Gradzka, Wiktoria (2020): Challenges of Food Waste Governance: An Assessment of European Legislation on Food Waste and Recommendations for Improvement by Economic Instruments. In *Land* 9 (7), p. 231. DOI: 10.3390/land9070231.

German Federal Ministry of Food and Agriculture (2019): Nationale Strategie zur Reduzierung der Lebensmittelverschwendung. Available online at https://www.bmel.de/SharedDocs/Downloads/Ernaehrung/Nationale_Strategie_Lebensmittelverschwendung_2019.pdf?__blob=publicationFile, checked on 3/9/2019.

GIZ (2021): SECTOR BRIEF ÄTHIOPIEN: Kaffee. With assistance of Roland Gross. Edited by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. GIZ; BMZ; AHK Eastern Africa. Eschbron. Available online at https://www.giz.de/en/downloads/SectorBrief_Aethiopien_Kaffee.pdf, checked on 8/25/2022.

Gogo, E. O.; Opiyo, A. M.; Hassenberg, K.; Ulrichs, Ch.; Huyskens-Keil, S. (2017): Postharvest UV-C treatment for extending shelf life and improving nutritional quality of African indigenous leafy vegetables. In *Postharvest Biology and Technology* 129, pp. 107–117. DOI: 10.1016/j.postharvbio.2017.03.019.

Gong, Weiwei; Li, Daoliang; Liu, Xue; Yue, Jun; Fu, Zetian (2007): Improved two-grade delayed particle swarm optimisation (TGDPSO) for inventory facility location for

perishable food distribution centres in Beijing. In *New Zealand Journal of Agricultural Research* 50 (5), pp. 771–779. DOI: 10.1080/00288230709510350.

Gustavsson, Jenny; Cederberg, Christel; Sonesson, Ulf (2011): Global food losses and food waste. Extent, causes and prevention ; study conducted for the International Congress Save Food! at Interpack 2011, [16 - 17 May], Düsseldorf, Germany. Rome: Food and Agriculture Organization of the United Nations.

Hafliðason, Tómas; Ólafsdóttir, Guðrún; Bogason, Sigurður; Stefánsson, Gunnar (2012): Criteria for temperature alerts in cod supply chains. In *Int Jnl Phys Dist & Log Manage* 42 (4), pp. 355–371. DOI: 10.1108/09600031211231335.

Haijema, René; Minner, Stefan (2016): Stock-level dependent ordering of perishables: A comparison of hybrid base-stock and constant order policies. In *International Journal of Production Economics* 181, pp. 215–225. DOI: 10.1016/j.ijpe.2015.10.013.

Handfield, R.; Straube, F.; Pfohl, H.-Chr.; Wieland, A. (2013): Trends and Stratagies in Logistics and Sopply Chain Management. Embracing Global Logistics Complexity to Drive Market Advantage. Hamburg: DVV Media Group GmbH.

Henningsson, Stefan; Hyde, Katherine; Smith, Ann; Campbell, Miranda (2004): The value of resource efficiency in the food industry: a waste minimisation project in East Anglia, UK. In *Journal of Cleaner Production* 12 (5), pp. 505–512. DOI: 10.1016/S0959-6526(03)00104-5.

Herbon, Avi; Khmelnitsky, Eugene (2017): Optimal dynamic pricing and ordering of a perishable product under additive effects of price and time on demand. In *European Journal of Operational Research* 260 (2), pp. 546–556. DOI: 10.1016/j.ejor.2016.12.033.

Hesse, Carsten; Jánszky, Sven Gábor (2014): Afrika 2025. Trendstudie des 2b AHEAD ThinkTanks. Edited by 2b AHEAD ThinkTank GmbH. Afrika-Verein der deutschen Wirtschaft e.V. Leipzig. Available online at http://www.afrikaverein.de/de/publikationen/, checked on 7/16/2018.

Hiç, Ceren; Pradhan, Prajal; Rybski, Diego; Kropp, Jürgen P. (2016): Food Surplus and Its Climate Burdens. In *Environmental science & technology* 50 (8), pp. 4269–4277. DOI: 10.1021/acs.est.5b05088.

HLPE (2014): Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome. Available online at http://www.fao.org/3/a-i3901e.pdf, checked on 6/5/2020.

How, Meng-Leong; Chan, Yong Jiet; Cheah, Sin-Mei (2020): Predictive Insights for Improving the Resilience of Global Food Security Using Artificial Intelligence. In *Sustainability* 12 (15), p. 6272. DOI: 10.3390/su12156272.

Hu, Hongtao; Zhang, Ye; Zhen, Lu (2017): A two-stage decomposition method on fresh product distribution problem. In *International Journal of Production Research* 55 (16), pp. 4729–4752. DOI: 10.1080/00207543.2017.1292062.

Ihle, Rico; Cramon-Taubadel, Stephan von; Zorya, Sergiy (2011): Measuring the Integration of Staple Food Markets in Sub-Saharan Africa: Heterogeneous Infrastructure and Cross Border Trade in the East African Community. In *CES IFO WORKING P APER NO. 3413* APRIL 2011. Available online at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1824172.

International Trade Centrer (2022): Trade Map. Edited by International Trade Centrer. Available online at https://www.trademap.org/Index.aspx, checked on 11/23/2022.

Irani, Zahir; Sharif, Amir M. (2016): Sustainable food security futures. In *Journal of Ent Info Management* 29 (2), pp. 171–178. DOI: 10.1108/JEIM-12-2015-0117.

Kaipia, Riikka; Dukovska-Popovska, Iskra; Loikkanen, Lauri (2013): Creating sustainable fresh food supply chains through waste reduction. In *Int Jnl Phys Dist & Log Manage* 43 (3), pp. 262–276. DOI: 10.1108/IJPDLM-11-2011-0200.

Kamble, Sachin S.; Gunasekaran, Angappa; Parekh, Harsh; Joshi, Sudhanshu (2019): Modeling the internet of things adoption barriers in food retail supply chains. In

Journal of Retailing and Consumer Services 48, pp. 154–168. DOI: 10.1016/j.jretconser.2019.02.020.

Kaya, Onur; Ghahroodi, Sajjad Rahimi (2018): Inventory control and pricing for perishable products under age and price dependent stochastic demand. In *Math Meth Oper Res* 88 (1), pp. 1–35. DOI: 10.1007/s00186-017-0626-9.

Keßler, Martin (2012): Gestaltung von Logistiknetzwerken für die humanitäre Versorgung in Entwicklungsländern Afrikas. Zugl.: Berlin, Techn. Univ., Diss., 2012. Berlin: Universitätsverl. der TU (Schriftenreihe Logistik der Technischen Universität Berlin, 20).

Kiil, Kasper; Dreyer, Heidi C.; Hvolby, Hans-Henrik; Chabada, Lukas (2018a): Sustainable food supply chains: the impact of automatic replenishment in grocery stores. In *Production Planning & Control* 29 (2), pp. 106–116. DOI: 10.1080/09537287.2017.1384077.

Kiil, Kasper; Hvolby, Hans-Henrik; Fraser, Kym; Dreyer, Heidi; Strandhagen, Jan Ola (2018b): Automatic replenishment of perishables in grocery retailing. In *British Food Journal* 120 (9), pp. 2033–2046. DOI: 10.1108/BFJ-10-2017-0547.

Kleineidam, Julia (2020): Fields of Action for Designing Measures to Avoid Food Losses in Logistics Networks. In *Sustainability* 12 (15), p. 6093. DOI: 10.3390/su12156093.

Kleineidam, Julia; Coll, Angelica; Straube, Frank (2022): Development of a readiness assessment tool as a result of a comparative analysis of engagement with food loss in Ethiopia and Germany. Clermont-Ferrand. 14th AIRL-SCM CONFERENCE.

Koester, Ulrich (2012): Wegwerfen von Lebensmitteln einerseits, hungernde Bevölkerung andererseits: Ineffizient und unmoralisch? In *IAMO Policy Brief* 2012 (7), pp. 1–5. Available online at https://nbn-resolving.de/urn:nbn:de:gbv:3:2-32021, checked on 8/26/2022.

Kouwenhoven, Gerry; Reddy Nalla, Vijayender; Lossonczy von Losoncz, Ton; IFAMR, IFAMA (2012): Creating Sustainable Businesses by Reducing Food Waste: A

Value Chain Framework for Eliminating Inefficiencies. In *International Food and Agribusiness Management Review* (15), pp. 119–138. Available online at https://ageconsearch.umn.edu/record/133489/, checked on 5/14/2020.

Kowalska, Aleksandra (2017): THE ISSUE OF FOOD LOSSES AND WASTE AND ITS DETERMINANTS. In *Logforum* 13 (1). DOI: 10.17270/J.LOG.2017.1.1.

Kranert, M.; Hafner, G.; Barabosz, J.; Schuller, H.; Levernez, D.; Kölbig, A. et al. (2012): Ermittlung der weggeworfenen Lebensmittelmengen und Vorschläge zur Verminderung der Wegwerfrate bei Lebensmitteln in Deutschland. Universität Stuttgart, Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft, Lehrstuhl für Abfallwirtschaft und Abluft; Universität für Bodenkultur Wien, Institut für Abfallwirtschaft. Stuttgart. Available online at https://www.bmel.de/SharedDocs/Downloads/DE/_Ernaehrung/Lebensmittelverschwendung/Studie_Lebensmittelabfaelle_Langfassung.pdf?__blob=publicationFile&v=3, checked on 8/26/2022.

La Scalia, G.; Aiello, G.; Miceli, A.; Nasca, A.; Alfonzo, A.; Settanni, L. (2016): Effect of Vibration on the Quality of Strawberry Fruits Caused by Simulated Transport. In *J Food Process Eng* 39 (2), pp. 140–156. DOI: 10.1111/jfpe.12207.

Lau, Henry; Nakandala, Dilupa; Shum, Paul Kwok (2018): A business process decision model for fresh-food supplier evaluation. In *Business Process Mgmt Journal* 24 (3), pp. 716–744. DOI: 10.1108/BPMJ-01-2016-0015.

Laux, C. M.; Mosher, G. A.; Hurburgh, C. R. (2015): Application of Quality Management Systems to Grain Handling: An Inventory Management Case Study. In *Appl. Eng. Agric.*, pp. 313–321. DOI: 10.13031/aea.31.10860.

Leśniewski, Piotr; Bartoszewicz, Andrzej (2013): LQ Optimal Sliding Mode Control of Periodic Review Perishable Inventories with Transportation Losses. In *Mathematical Problems in Engineering* 2013 (3), pp. 1–9. DOI: 10.1155/2013/325274.

Liljestrand, Kristina (2017): Logistics solutions for reducing food waste. In *Int Jnl Phys Dist & Log Manage* 47 (4), pp. 318–339. DOI: 10.1108/IJPDLM-03-2016-0085.

Lozano, S.; Adenso-Díaz, B. (2018): Increasing Sustainability of Logistic Networks by Reducing Product Losses: A Network DEA Approach. In *Mathematical Problems in Engineering* 2018 (1), pp. 1–21. DOI: 10.1155/2018/3479251.

Lutz, Juliana; Smetschka, Barbara; Grima, Nelson (2017): Farmer Cooperation as a Means for Creating Local Food Systems—Potentials and Challenges. In *Sustainability* 9 (6), p. 925. DOI: 10.3390/su9060925.

Mack, Miriam; Dittmer, Patrick; Veigt, Marius; Kus, Mehmet; Nehmiz, Ulfert; Kreyenschmidt, Judith (2014): Quality tracing in meat supply chains. In *Philosophical Transactions of the Royal Society A-Mathematical Physical and Engineering Sciences* 372 (2017), p. 20130308. DOI: 10.1098/rsta.2013.0308.

Magalhães, Vanessa S.M.; Ferreira, Luís Miguel D.F.; Silva, Cristóvão (2022): A framework to evaluate and rank mitigation strategies for food loss and waste: An analysis along the fruit and vegetable supply chain. In *Sustainable Production and Consumption*. DOI: 10.1016/j.spc.2022.03.022.

Manners-Bell, John (2013): Global logistics strategies. Delivering the goods. London: Kogan Page. Available online at http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=653156.

Manners-Bell, John (2017): Supply Chain Ethics. Using CSR and Sustainability to Create Competitive Advantage. 1st ed. London: Kogan Page. Available online at https://ebookcentral.proquest.com/lib/gbv/detail.action?docID=4813095.

Manzouri, Malihe; Ab-Rahman, Mohd; Zain, Che; Jamsari, Ezad (2014): Increasing Production and Eliminating Waste through Lean Tools and Techniques for Halal Food Companies. In *Sustainability* 6 (12), pp. 9179–9204. DOI: 10.3390/su6129179.

Markelova, Helen; Mwangi, Esther (2010): Collective Action for Smallholder Market Access: Evidence and Implications for Africa. In *Review of Policy Research* 27 (5), pp. 621–640. DOI: 10.1111/j.1541-1338.2010.00462.x.

Martens, Bobby J.; Scheibe, Kevin P.; Bergey, Paul K. (2012): Supply Chains in Sub-Saharan Africa: A Decision Support System for Small-Scale Seed Entrepreneurs*. In *Decision Sciences* 43 (5), pp. 737–759. DOI: 10.1111/j.1540-5915.2012.00370.x.

Martindale, Wayne (2017): The potential of food preservation to reduce food waste. In *The Proceedings of the Nutrition Society* 76 (1), pp. 28–33. DOI: 10.1017/S0029665116000604.

Martindale, Wayne; Schiebel, Walter (2017): The impact of food preservation on food waste. In *British Food Journal* 119 (12), pp. 2510–2518. DOI: 10.1108/BFJ-02-2017-0114.

Melin, Martin; Barth, Henrik (2018): Lean in Swedish agriculture: strategic and operational perspectives. In *Production Planning & Control* 29 (10), pp. 845–855. DOI: 10.1080/09537287.2018.1479784.

Melkamu T Wazza (2022): Ten Years Development Plan of Ethiopia (2021-2030): A Critical Review.

Memon, Muhammad Ali; Karray, Mohamed Hedi; Letouzey, Agnès; Archimède, Bernard (2017): Semantic transportation planning for food products supply chain ecosystem within difficult geographic zones. In *Industr Mngmnt & Data Systems* 117 (9), pp. 2064–2084. DOI: 10.1108/IMDS-10-2016-0459.

Mena, Carlos; Terry, Leon A.; Williams, Adrian; Ellram, Lisa (2014): Causes of waste across multi-tier supply networks: Cases in the UK food sector. In *International Journal of Production Economics* 152, pp. 144–158. DOI: 10.1016/j.ijpe.2014.03.012.

Mendedo, Eyerusalem Kassa; Berhane, Yemaneh; Haile, Biniyam Tadesse (2017): Factors associated with sanitary conditions of food and drinking establishments in Addis Ababa, Ethiopia: cross-sectional study. In *Pan African Medical Journal* 28, p. 237. DOI: 10.11604/pamj.2017.28.237.13734.

Mercier, Samuel; Mondor, Martin; Villeneuve, Sébastien; Marcos, Bernard (2018): The Canadian food cold chain: A legislative, scientific, and prospective overview. In

International Journal of Refrigeration-Revue Internationale Du Froid 88, pp. 637–645. DOI: 10.1016/j.ijrefrig.2018.01.006.

Minten, Bart; Tamru, Seneshaw; Reardon, Thomas (2021): Post-harvest losses in rural-urban value chains: Evidence from Ethiopia. In *Food Policy* 98 (2), p. 101860. DOI: 10.1016/j.foodpol.2020.101860.

Molina-Besch, Katrin; Wikström, Fredrik; Williams, Helén (2019): The environmental impact of packaging in food supply chains—does life cycle assessment of food provide the full picture? In *International Journal of Life Cycle Assessment* 24 (1), pp. 37–50. DOI: 10.1007/s11367-018-1500-6.

Mor, Rahul S.; Bhardwaj, Arvind; Singh, Sarbjit (2018): Benchmarking the interactions among performance indicators in dairy supply chain. In *Benchmarking-An International Journal* 25 (9), pp. 3858–3881. DOI: 10.1108/BIJ-09-2017-0254.

Muriana, Cinzia (2017): A focus on the state of the art of food waste/losses issue and suggestions for future researches. In *Waste management (New York, N.Y.)* 68, pp. 557–570. DOI: 10.1016/j.wasman.2017.06.047.

Mvumi, Brighton; Matsikira, Learnmore Tatenda; Mutambara, Jackqeline (2016): The banana postharvest value chain analysis in Zimbabwe. In *British Food Journal* 118 (2), pp. 272–285. DOI: 10.1108/BFJ-08-2014-0293.

Nabhani, Farhad; Shokri, Alireza (2009): Reducing the delivery lead time in a food distribution SME through the implementation of six sigma methodology. In *Jnl of Manu Tech Mnagmnt* 20 (7), pp. 957–974. DOI: 10.1108/17410380910984221.

Närvänen, Elina; Mattila, Malla; Mesiranta, Nina (2021): Institutional work in food waste reduction: Start-ups' role in moving towards a circular economy. In *Industrial Marketing Management* 93 (2), pp. 605–616. DOI: 10.1016/j.indmarman.2020.08.009.

Negi, Saurav; Anand, Neeraj (2019): Wholesalers perspectives on mango supply chain efficiency in India. In *J of Agribus in Dev & Em Econ* 9 (2), pp. 175–200. DOI: 10.1108/JADEE-02-2018-0032.

Nitsche, Benjamin; Durach, Christian F. (2018): Much discussed, little conceptualized: supply chain volatility. In *Int Jnl Phys Dist & Log Manage* 48 (8), pp. 866–886. DOI: 10.1108/IJPDLM-02-2017-0078.

Nitsche, Benjamin; Kleineidam, Julia; Straube, Frank; Meißner, Melanie (2018): SYSTEMATIZATION AND DISCUSSION OF THE CURRENT STATE OF WASTE MANAGEMENT IN FOOD SUPPLY CHAINS. A SYSTEMATIC REVIEW. In *The Journal of Japanese Operations Management and Strategy* (Vol. 8), pp. 1–17.

Notarnicola, Bruno; Sala, Serenella; Anton, Assumpció; McLaren, Sarah J.; Saouter, Erwan; Sonesson, Ulf (2017): The role of life cycle assessment in supporting sustainable agri-food systems: A review of the challenges. In *Journal of Cleaner Production* 140, pp. 399–409. DOI: 10.1016/j.jclepro.2016.06.071.

Ocicka, Barbara; Raźniewska, Marta (2018): FOOD WASTE REDUCTION AS A CHALLENGE IN SUPPLY CHAINS MANAGEMENT. In *Logforum* 14 (4), pp. 549–561. DOI: 10.17270/J.LOG.2018.303.

Orjuela Castro, Javier Arturo; Adarme Jaimes, Wilson (2017): Dynamic impact of the structure of the supply chain of perishable foods on logistics performance and food security. In *Journal of Industrial Engineering and Management-Jiem* 10 (4), p. 687. DOI: 10.3926/jiem.2147.

Pan, Shenle; Giannikas, Vaggelis; Han, Yufei; Grover-Silva, Etta; Qiao, Bin (2017): Using customer-related data to enhance e-grocery home delivery. In *Industrial Management & Data Systems* 117 (9), pp. 1917–1933. DOI: 10.1108/IMDS-10-2016-0432.

Papargyropoulou, Effie; Lozano, Rodrigo; K. Steinberger, Julia; Wright, Nigel; Ujang, Zaini bin (2014): The food waste hierarchy as a framework for the management of food surplus and food waste. In *Journal of Cleaner Production* 76, pp. 106–115. DOI: 10.1016/j.jclepro.2014.04.020.

Parfitt, J.; Barthel, M.; Macnaughton, S. (2010): Food waste within food supply chains: quantification and potential for change to 2050. In *Philosophical Transactions of*

the Royal Society B: Biological Sciences 365 (1554), pp. 3065–3081. DOI: 10.1098/rstb.2010.0126.

Pfohl, Hans-Christian (2018): Logistiksysteme. Berlin, Heidelberg: Springer Berlin Heidelberg.

Pfohl, Hans-Christian; Feldkamp, Winfried (Eds.) (2001): Jahrhundert der Logistik. Wertsteigerung des Unternehmens: customer related - glocal - e-based ; 16. Fachtagung Institut für Logistik, 12. Juni 2001, Darmstadt. Technische Universität Darmstadt; Institut für Logistik. Darmstadt: Erich Schmidt Verlag; E. Schmidt (Unternehmensführung und Logistik, 19).

Pfohl, Hans-Christian; Müller, Katja (2015): COLLABORATION AND COMMUNICATION IN A NETWORKED ECONOMY. In *Logforum* 11 (2), Article 2, pp. 139–149. DOI: 10.17270/J.LOG.2015.2.2.

Pinior, Beate; Conraths, Franz J.; Petersen, Brigitte; Selhorst, Thomas (2015): Decision support for risks managers in the case of deliberate food contamination: The dairy industry as an example. In *Omega-International Journal of Management Science* 53, pp. 41–48. DOI: 10.1016/j.omega.2014.09.011.

Pinstrup-Andersen, Per (2014): Contemporary food policy challenges and opportunities. In *Aust J Agric Resour Econ* 58 (4), pp. 504–518. DOI: 10.1111/1467-8489.12019.

Poppe, Ronald (2017): Kooperationsplattformen für das Supply Chain Management. Dissertation.

Powell, Daryl; Lundeby, Sissel; Chabada, Lukas; Dreyer, Heidi (2017): Lean Six Sigma and environmental sustainability: the case of a Norwegian dairy producer. In *International Journal of Lean Six Sigma* 8 (1), pp. 53–64. DOI: 10.1108/IJLSS-06-2015-0024.

Raab, Verena; Petersen, Brigitte; Kreyenschmidt, Judith (2011): Temperature monitoring in meat supply chains. In *British Food Journal* 113 (10), pp. 1267–1289. DOI: 10.1108/00070701111177683.

Raut, Rakesh; Gardas, Bhaskar B. (2018): Sustainable logistics barriers of fruits and vegetables. In *Benchmarking-An International Journal* 25 (8), pp. 2589–2610. DOI: 10.1108/BIJ-07-2017-0166.

Reinders, Heinz; Ditton, Hartmut; Gräsel, Cornelia; Gniewosz, Burkhard (2011): Empirische Bildungsforschung. Wiesbaden: VS Verlag für Sozialwissenschaften.

Sarpong, Sam (2014): Traceability and supply chain complexity: confronting the issues and concerns. In *European Business Review* 26 (3), pp. 271–284. DOI: 10.1108/EBR-09-2013-0113.

Sarris, Alexander; Morrison, Jamie (2010): Food security in Africa. Market and trade policy for staple foods in Eastern and southern Africa. Cheltenham, Northampton, MA: Edward Elgar Pub. Available online at http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10431377.

Saunders, Mark; Lewis, Philip; Thornhill, Adrian (2016): Research methods for business students. 7. ed. Harlow: Pearson.

Schulz, Sabine Friederike (2009): Disaster relief logistics. Benefits of and impediments to cooperation between humanitarian organizations. Zugl.: Berlin, Techn. Univ., Diss., 2009. 1. ed. Berne: Haupt (Kuehne Foundation book series on logistics, 15).

Schwarz, Jennifer Rebecca (2012): Humanitäre Logistik für die Versorgungsproblematik in Subsahara-Afrika. Aufbau von Logistikkapazität durch Wissenstransfer. Zugl.: Berlin, Techn. Univ., Diss., 2012. Berlin: Universitätsverl. der TU (Schriftenreihe Logistik der Technischen Universität Berlin, 21).

Shah, Satya R.; Naghi Ganji, Elmira (2017): Lean production and supply chain innovation in baked foods supplier to improve performance. In *British Food Journal* 119 (11), pp. 2421–2447. DOI: 10.1108/BFJ-03-2017-0122.

Sharifzadeh, Mahdi; Garcia, Marti Cortada; Shah, Nilay (2015): Supply chain network design and operation: Systematic decision-making for centralized, distributed, and mobile biofuel production using mixed integer linear programming (MILP) under

uncertainty. In *Biomass and Bioenergy* 81, pp. 401–414. DOI: 10.1016/j.biombioe.2015.07.026.

Sharma, Poonam; Gaur, Vivek K.; Sirohi, Ranjna; Varjani, Sunita; Hyoun Kim, Sang; Wong, Jonathan W. C. (2021): Sustainable processing of food waste for production of bio-based products for circular bioeconomy. In *Bioresource Technology* 325, p. 124684. DOI: 10.1016/j.biortech.2021.124684.

Sharma, Yogesh Kumar; Mangla, Sachin Kumar; Patil, Pravin P.; Liu, Shaofeng (2019): When challenges impede the process. In *Management Decision* 57 (4), pp. 995–1017. DOI: 10.1108/MD-09-2018-1056.

Singh, Adarsh Kumar; Subramanian, Nachiappan; Pawar, Kulwant Singh; Bai, Ruibin (2018): Cold chain configuration design: location-allocation decision-making using coordination, value deterioration, and big data approximation. In *Ann Oper Res* 270 (1-2), pp. 433–457. DOI: 10.1007/s10479-016-2332-z.

Smil, Vaclav (2004): Improving Efficiency and Reducing Waste in Our Food System. In *Environmental Sciences* 1 (1), pp. 17–26. DOI: 10.1076/evms.1.1.17.23766.

Smith, David; Sparks, Leigh (2009): Temperature controlledsupply chains. In John Fernie, Leigh Sparks (Eds.): Logistics & retail management. Emerging issues and new challenges in the retail supply chain. 3. ed. London, Philadelphia: Kogan Page Ltd, pp. 172–188. Available online at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.454.9332&rep=rep1&type=pdf#page=193, checked on 2/9/2020.

Solino Coffee (2014): Was wäre wenn Äthiopien nur gerösteten Kaffee exportieren würde? Available online at https://www.solino-coffee.com/allgemein/geroesteter-kaffee-export-aus-aethiopien/, updated on 8/24/2022.

Song, Zilong; He, Shiwei (2019): Contract coordination of new fresh produce three-layer supply chain. In *Industr Mngmnt & Data Systems* 119 (1), pp. 148–169. DOI: 10.1108/IMDS-12-2017-0559.

Straube, Frank (2004): e-Logistik. Ganzheitliches Logistikmanagement. Zugl.: St. Gallen, Univ., Habil.-Schr. Berlin: Springer.

Straube, Frank; Nitsche, Benjamin; Figiel, Anna (2016): Zukunftstrends in der Lebensmittellogistik – Herausforderungen und Lösungsimpulse. Berlin: Universitätsverlag der TU Berlin.

Strotmann, Christina; Göbel, Christine; Friedrich, Silke; Kreyenschmidt, Judith; Ritter, Guido; Teitscheid, Petra (2017): A Participatory Approach to Minimizing Food Waste in the Food Industry—A Manual for Managers. In *Sustainability* 9 (1), p. 66. DOI: 10.3390/su9010066.

The Federal Democratic Republic of Ethiopia (2010): Growth and Transformation Plan (GTP) 2010/11-2014/15. Draft. Edited by Ministry of Finance and Economic Development (MoFED). Addis Ababa. Available online at https://theredddesk.org/sites/default/files/growth_and_transformation_plan.pdf, checked on 7/16/2018.

The Federal Government of the Federal Republic of Germany (2017a): Wirtschaftliche Entwicklung Afrikas. Herausforderungen und Optionen. Edited by Die Bundesgerierung. Die Bundesgerierung.

The Federal Government of the Federal Republic of Germany (2017b): Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Niema Movassat, Annette Groth, Heike Hänsel, Andrej Hunko und der Fraktion DIE LINKE. Deutscher Bundestag, 18. Wahlperiode. Berlin (Deutscher Bundestag, Drucksache 18/13697). Available online at http://dipbt.bundestag.de/doc/btd/18/136/1813697.pdf, checked on 7/16/2018.

THE UNITED REPUBLIC OF TANZANIA (2021): NATIONAL FIVE YEAR DEVELOPMENT PLAN 2021/22 - 2025/26. Realising Competitiveness and Industrialisation for Human Development. Edited by MINISTRY OF FINANCE AND PLANNING. Available online at https://www.tro.go.tz/wp-content/uploads/2021/06/FYDP-III-English.pdf, checked on 11/23/2022.

Ting, S. L.; Tse, Y. K.; Ho, G.T.S.; Chung, S. H.; Pang, G. (2014): Mining logistics data to assure the quality in a sustainable food supply chain: A case in the red wine

industry. In *International Journal of Production Economics* 152, pp. 200–209. DOI: 10.1016/j.ijpe.2013.12.010.

Tromp, Seth-Oscar; Rijgersberg, Hajo; Pereira da Silva, Fátima; Bartels, Paul (2012): Retail benefits of dynamic expiry dates—Simulating opportunity losses due to product loss, discount policy and out of stock. In *International Journal of Production Economics* 139 (1), pp. 14–21. DOI: 10.1016/j.ijpe.2011.04.029.

Tsang, Y. P.; Choy, K. L.; Wu, C. H.; Ho, G.T.S.; Lam, H. Y.; Tang, Valerie (2018): An intelligent model for assuring food quality in managing a multi-temperature food distribution centre. In *Food Control* 90, pp. 81–97. DOI: 10.1016/j.foodcont.2018.02.030.

Tsuchiya, Kazuaki; Hara, Yuji; Thaitakoo, Danai (2015): Linking food and land systems for sustainable peri-urban agriculture in Bangkok Metropolitan Region. In *Landscape and Urban Planning* 143, pp. 192–204. DOI: 10.1016/j.landurbplan.2015.07.008.

Ulrich, Peter (2001): Integrative Wirtschaftsethik. Grundlagen einer lebensdienlichen Ökonomie. 3., rev. Aufl. Bern: Haupt.

UN DESA (2018): Prognose zur Entwicklung der Weltbevölkerung von 2010 bis 2100 (in Milliarden) (Statista - Das Statistik-Portal). Available online at https://de.statista.com/statistik/daten/studie/1717/umfrage/prognose-zur-entwicklung-der-weltbevoelkerung/., checked on 9/4/2018.

UNEP (2018): Africa Waste Management Outlook. United Nations Environment Programme. Nairobi, Kenya. Available online at https://wedocs.unep.org/bitstream/handle/20.500.11822/25514/Africa_WMO.pdf?sequence=1&isAllowed=y, checked on 6/8/2018.

UNITED NATIONS (2015a): Sustainable development goals. 17 Goals to Transform Our World. Edited by UNITED NATIONS. UNITED NATIONS. sustainabledevelopment.un.org. Available online at https://sustainabledevelopment.un.org/post2015/transformingourworld/publication, checked on 2/18/2022.

UNITED NATIONS (2015b): TRANSFORMING OUR WORLD. THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT. Available online at https://sustainabledevelopment.un.org/index.php?menu=1375&year=2015, checked on 3/1/2019.

UNITED NATIONS (2017): World Population Prospects: The 2017 Revision. Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248. With assistance of Department of Economic and Social Affairs, Population Divisio. Available online at https://population.un.org/wpp/Publications/Files/WPP2017_KeyFindings.pdf, checked on 3/7/2019.

United Nations Environment Programme (2021): Food Waste Index Report 2021. With assistance of Hamish Forbes (WRAP), Tom Quested (WRAP), Clementine O'Connor (United Nations Environment Programme). Nairobi, Kenya.

Validi, Sahar; Bhattacharya, Arijit; Byrne, P. J. (2014): A case analysis of a sustainable food supply chain distribution system—A multi-objective approach. In *International Journal of Production Economics* 152, pp. 71–87. DOI: 10.1016/j.ijpe.2014.02.003.

van der Vorst, Jack; van Kooten, Olaf; Luning, Pieternel A. (2011): Towards a Diagnostic Instrument to Identify Improvement Opportunities for Quality Controlled Logistics in Agrifood Supply Chain Networks. International Journal on Food System Dynamics, Vol 2, No 1 (2011) / International Journal on Food System Dynamics, Vol 2, No 1 (2011). DOI: 10.18461/ijfsd.v2i1.217.

van Hoof, Bart; Lyon, Thomas P. (2013): Cleaner production in small firms taking part in Mexico's Sustainable Supplier Program. In *Journal of Cleaner Production* 41, pp. 270–282. DOI: 10.1016/j.jclepro.2012.09.023.

Vanderroost, Mike; Ragaert, Peter; Verwaeren, Jan; Meulenaer, Bruno de; Baets, Bernard de; Devlieghere, Frank (2017): The digitization of a food package's life cycle: Existing and emerging computer systems in the logistics and post-logistics phase. In *Computers in Industry* 87, pp. 15–30. DOI: 10.1016/j.compind.2017.01.004.

Venuto, Daniela de; Mezzina, Giovanni (2018): Spatio-Temporal Optimization of Perishable Goods' Shelf Life by a Pro-Active WSN-Based Architecture. In *Sensors* 18 (7). DOI: 10.3390/s18072126.

Verghese, Karli; Lewis, Helen; Lockrey, Simon; Williams, Helén (2015): Packaging's Role in Minimizing Food Loss and Waste Across the Supply Chain. In *Packag. Technol. Sci.* 28 (7), pp. 603–620. DOI: 10.1002/pts.2127.

Vlachos, Ilias (2015): Applying lean thinking in the food supply chains: a case study. In *Production Planning & Control* 26 (16), pp. 1351–1367. DOI: 10.1080/09537287.2015.1049238.

Wang, Lixing; Kowk, S. K.; Ip, W. H. (2012): A radio frequency identification-based quality evaluation system design for the wine industry. In *International Journal of Computer Integrated Manufacturing* 25 (1), pp. 11–19. DOI: 10.1080/0951192X.2011.562542.

Warshawsky, Daniel N. (2016): Food waste, sustainability, and the corporate sector: case study of a US food company. In *Geographical Journal* 182 (4), pp. 384–394. DOI: 10.1111/geoj.12156.

Weidner, Till; Yang, Aidong; Hamm, Michael W. (2019): Consolidating the current knowledge on urban agriculture in productive urban food systems: Learnings, gaps and outlook. In *Journal of Cleaner Production* 209, pp. 1637–1655. DOI: 10.1016/j.jclepro.2018.11.004.

Wikström, Fredrik; Verghese, Karli; Auras, Rafael; Olsson, Annika; Williams, Helén; Wever, Renee et al. (2019): Packaging Strategies That Save Food: A Research Agenda for 2030. In *Journal of Industrial Ecology* 23 (3), pp. 532–540. DOI: 10.1111/jiec.12769.

Wikström, Fredrik; Williams, Helén; Verghese, Karli; Clune, Stephen (2014): The influence of packaging attributes on consumer behaviour in food-packaging life cycle assessment studies - a neglected topic. In *Journal of Cleaner Production* 73, pp. 100–108. DOI: 10.1016/j.jclepro.2013.10.042.

Wilcock, Anne E.; Boys, Kathryn A. (2017): Improving quality management: ISO 9001 benefits for agrifood firms. In *J of Agribus in Dev & Em Econ* 7 (1), pp. 2–20. DOI: 10.1108/JADEE-12-2014-0046.

Wojciechowska-Solis, Julia; Barska, Anetta (2021): Exploring the Preferences of Consumers' Organic Products in Aspects of Sustainable Consumption: The Case of the Polish Consumer. In *Agriculture-Basel* 11 (2), p. 138. DOI: 10.3390/agriculture11020138.

World Bank (2014): Unleashing the Potential of Ethiopia's Export Industry. With assistance of Lars Christian Moller. Available online at https://www.worldbank.org/en/country/ethiopia/publication/ethiopia-economic-update-strengthening-export-performance-through-improved-competitiveness, checked on 8/25/2022.

World Bank (2018): Country Score Card: Germany 2018. Available online at https://lpi.worldbank.org/international/scorecard/radar/254/C/DEU/2018/I/OEC/2018?featured=18.

World Bank (2019): GDP growth Ethiopia (annual %). World Bank national accounts data, and OECD National Accounts data files. Available online at https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=ET&name_desc=false, checked on 3/8/2019.

Wu, Kuo-Jui; Liao, Ching-Jong; Tseng, MingLang; Chiu, Kevin Kuan-Shun (2016): Multi-attribute approach to sustainable supply chain management under uncertainty. In *Industr Mngmnt & Data Systems* 116 (4), pp. 777–800. DOI: 10.1108/IMDS-08-2015-0327.

Wu, Linhai; Hu, Qipeng; Wang, Jianhua; Zhu, Dian (2017): Empirical analysis of the main factors influencing rice harvest losses based on sampling survey data of ten provinces in China. In *China Ag Economic Review* 9 (2), pp. 287–302. DOI: 10.1108/CAER-03-2016-0036.

Xiao, Xinqing; He, Qile; Li, Zhigang; Antoce, Arina Oana; Zhang, Xiaoshuan (2017): Improving traceability and transparency of table grapes cold chain logistics by

integrating WSN and correlation analysis. In *Food Control* 73, pp. 1556–1563. DOI: 10.1016/j.foodcont.2016.11.019.

Yadav, Prashant (2015): Health Product Supply Chains in Developing Countries: Diagnosis of the Root Causes of Underperformance and an Agenda for Reform. In *Health Systems & Reform* 1 (2), pp. 142–154. DOI: 10.4161/23288604.2014.968005.

Yu, Juan; Gan, Mi; Ni, Shaoquan; Chen, Dingjun (2018): Multi-objective models and real case study for dual-channel FAP supply chain network design with fuzzy information. In *J Intell Manuf* 29 (2), pp. 389–403. DOI: 10.1007/s10845-015-1115-8.

Yu, Min; Nagurney, Anna (2012): Competitive Food Supply Chain Networks with Application to Fresh Produce. In *SSRN Journal*. DOI: 10.2139/ssrn.2025471.

Zhong, Ray; Xu, Xun; Wang, Lihui (2017): Food supply chain management: systems, implementations, and future research. In *Industr Mngmnt & Data Systems* 117 (9), pp. 2085–2114. DOI: 10.1108/IMDS-09-2016-0391.

Zhou, Linan; Zhou, Gengui; Qi, Fangzhong; Li, Hangying (2019): Research on coordination mechanism for fresh agri-food supply chain with option contracts. In *Kybernetes* 48 (5), pp. 1134–1156. DOI: 10.1108/K-08-2017-0291.

10 Appendix - Readiness assessment questionnaire

10.1 Strategy-level

	1 completely inapplicable	2	3 rather inapplicable	4	5 rather applicable	6	7 completely applicable
We have an exact overview of losses in our processes and can quantify them.							
We have an accurate overview of financial expenses that cause food losses and can quantify them.							
Management leads by making food loss reduction management a key strategic issue and supporting continuous improvement.							
The organization's specific food loss reduction management objectives and requirements are properly defined.							
Food loss reduction management activities are included in the organizations' business plans and continuous improvement tools are defined.							
For food loss reduction management, an organizational structure which demands and utilizes the full potential of the workforce is implemented.							
Targeted communication is used to increase food loss awareness and participation and reinforce the message.							

10.2 Network-level

	1 completely inapplicable	2	3 rather inapplicable	4	5 rather applicable	6	7 completely applicable
We provide our direct network partners with information about our food losses on a regular basis.							
Our direct network partners provide us with information about their food losses on a regular basis.							
If we receive spoiled/inappropriate food products from a supplier, we have agreed processes with our suppliers on how to deal with this food products.							
If our customers receive spoiled/inappropriate food from us, we have agreed processes with our customers on how to deal with this food products.							
We work with our network partners on joint projects to reduce losses across company boundaries.							

10.3 Processes-level

	1 completely inapplicable	2	3 rather inapplicable	4	5 rather applicable	6	7 completely applicable
The organization prepares sales forecasts that regularly nearly reflect reality.							
There is a documented process description that identifies known causes of losses and highlights avoidance strategies.							
The organization has clear, formalized procedures for collecting food loss data.							
The organization has specific, formalized procedures for dealing with food losses that occur.							

	Disposal		Recovery energy e.g. via anaerobic digestion		Recycle food loss into animal feed or via composting		Re-use surplus food for human consumption (e.g., food banks)
Which of the following is the most common form of utilization used by the organization for food losses?							

	No storage strategies in place		LIFO (Last-in, first-out)		FIFO (First-in, first-out)		FEFO (First-expired, first-out)
What is the organizations' storage strategy for perishable products?							

10.4 Technologies-level

	1 completely inapplicable	2	3 rather inapplicable	4	5 rather applicable	6	7 completely applicable
Information technologies are used very efficiently in the organization to collect data on food losses.							
Information technologies are used very efficiently in the organization to increase transparency regarding food losses.							
The organization regularly reviews new technologies for their potential to improve the organization's food loss reduction management.							
Electronic data interfaces have been established with network partners to share food loss data.							

10.5 Employees-level

	1 completely inapplicable	2	3 rather inapplicable	4	5 rather applicable	6	7 completely applicable
The organization's employees are regularly trained on food handling and food loss prevention.							
The organization's employees are regularly provided with data on the volume of food losses within the organization in order to create transparency.							
The organization's employees with decision-making authority are provided with all necessary information regarding food losses to support decision-making.							
Through an incentive system, employees are motivated to make suggestions for process improvements that will lead to the reduction of food losses.							