Local actors' perspectives on sustainable food value chains : evidence from a Q-methodology study in Kenya

Local actors' perspectives on sustainable food value chains: evidence from a Q-methodology study in Kenya.

1. Introduction

The Horn of Africa has been facing its worst drought for over four decades (United Nations, 2022). More than 19 million people have been affected since October 2020, and this number is expected to increase. Crop production is failing and millions of livestock are dying (United Nations, 2022). This indicates that food systems are increasingly affected by climate change. As a result, food value chain actors' incomes are fluctuating, global food prices are rising, and resources are being depleted (FAO, 2013; Godde, et al., 2021; Slay & Dooley, 2020). These climate change-related value chain disruptions are expected to increase the gap between developed and developing countries (FAO, 2013). In combination with the rapidly growing population, food waste, and rising urbanization, food value chains are under increasing pressure in terms of quantity and quality (AGRA, 2016; Liverpool-Tasie, et al., 2020). The Food and Agriculture Organization (FAO) (2013) estimates that agricultural production will have to increase by approximately 60% by 2050 to satisfy the expected demand for food and animal feed. Creating more efficient and sustainable food value chains could have a significantly positive effect on food security and the environment.

Food value chains consisting of all stakeholders who participate in the coordinated production and value-adding activities needed to make food products, need to be transformed to guarantee food security in the future (FAO, 2022). Several international organizations, including the FAO (2022), The Global Environment Facility (GEF) (2020), and The International Fund for Agricultural Development (IFAD) (2015), recognized that the development of sustainable and resilient value chains is needed to reduce food insecurity, poverty, and environmental footprints. According to the Sustainable Food Value Chains Knowledge Platform, a sustainable food value chain (SFVC) can be defined as a food value chain that: "(1) is profitable throughout all of its stages (economic sustainability); (2) has broad-based benefits for society (social sustainability); (3) has a positive or neutral impact on the natural environment (environmental sustainability)" (FAO, 2022).

Sustainability in different domains is the main goal of SFVCs. Although world leaders, researchers, and international organizations all agree that sustainability is needed, progress is slow (Eurostat, 2020; United Nations, 2012). The United Nations 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) allow for measuring and evaluating the performance of countries regarding these goals. The 2019 Africa SDG Index and Dashboard Report demonstrated that, overall, African countries perform poorly on most targets. The report also stated that although 89% of African governments officially endorse the SDGs, they have a limited understanding of what it will take to achieve the SDGs (SDG Center for Africa and Sustainable Development Solutions Network, 2019). This lack of understanding of what it will take to achieve the SDGs might relate to the different interpretations and definitions of 'sustainability' (Byrch, Kearins, Milne, & Morgan, 2007; Whyte & Lamberton, 2020). Sustainability is a concept that is used in various fields and contexts. This study focuses on sustainability in relation to (short) food value chains.

The goal of this research is to create a better understanding of what African food value chain actors care about and which obstacles to more SFVCs they identify. Currently, research on sustainability and SFVCs is often based on Western perspectives, neglecting other viewpoints (Glasson, Mhango, Phiri, & Lanier, 2010). This is further discussed in the next section (section 1.2). Yet, several researchers agree

that “different cultures and their respective knowledge systems should partake in the sustainability debate” (Mazzocchi, 2020, p. 77). Therefore, this research will start by improving the understanding of SFVCs before strategizing ways to improve the sustainability of the chain(s). More specifically, the research questions addressed in this paper are (1) ‘How do African food value chain actors understand SFVCs?’ and (2) ‘Which are the most important characteristics of SFVCs according to African food value chain actors?’. Food value chain actors include input providers, farmers, distributors, intermediaries, extension officers, transporters, food processors, retailers, consumers, and researchers (Braun, Bitsch, & Häring, 2021; Kamrath, Wesana, Broring, & De Steur, 2019; Stein & Barron, 2017).

2. Literature review

2.1. Different perceptions of sustainability and SFVCs

Innovation and research predominantly revolve around Western lifestyles, and this bias is also evident in studies on sustainability and SFVCs (Glasson, Mhango, Phiri, & Lanier, 2010; Mazzocchi, 2020). However, the existing body of literature on the perception and knowledge of food value chain actors regarding sustainability in Africa remains relatively limited. We can distinguish two categories of publications. Firstly, studies on capturing diverse understandings and definitions of sustainability. For instance, Owens and Legere (2015) discovered significant variations in how faculty, staff, and students at a university in the United States comprehend and define sustainability, which deviates from the established definitions in sustainability literature. Similarly, Fifka et al. (2016) explored the understanding of sustainability among Latin American NGOs and revealed that the concept can be broadly interpreted, leading to the identification of eight distinct research categories of sustainability. Finally, Aminpour et al. (2020) explored the perspectives of scholars from different disciplines on the sustainability of social-ecological systems. They concluded that there is a divide between scholars from developing and developed countries in terms of understanding and defining sustainability. This division may pose additional challenges for global sustainability research.

The second set of publications concentrates on one specific segment of the food value chain, such as farmers or consumers. For example, numerous studies have explored the perception and knowledge of African farmers regarding sustainable agriculture (Ajayi, 2007; Meijer, Catacutan, Ajayi, Sileshi, & Nieuwenhuis, 2015; Villholth, 2013). One of the main conclusions of Moraine et al. (2016) and Marandure et al. (2020) was the disconnection between experts' and farmers' perceptions of sustainable farming. While experts tend to emphasize technical aspects, farmers approach it from a practical standpoint. There are also several studies on consumers’ attitudes and knowledge of sustainable food, yet, mainly in developed countries (Anvar & Venter, 2014; Vanhonacker, Van Loo, Gellynck, & Verbeke, 2013; Yang, Shen, Foster, & Hort, 2020). The few studies that have been done in developing countries have found a broad acceptance of sustainable food – specifically plant-based and cultivated meat – among consumers across all segments of society, especially among the younger population (Szejda, et al., 2021). Another South African study found that environmental awareness, along with social influence and price, positively influenced individuals’ attitudes towards green products. Moreover, consumers with favorable attitudes towards green products demonstrated a higher likelihood of making purchases (Anvar & Venter, 2014).

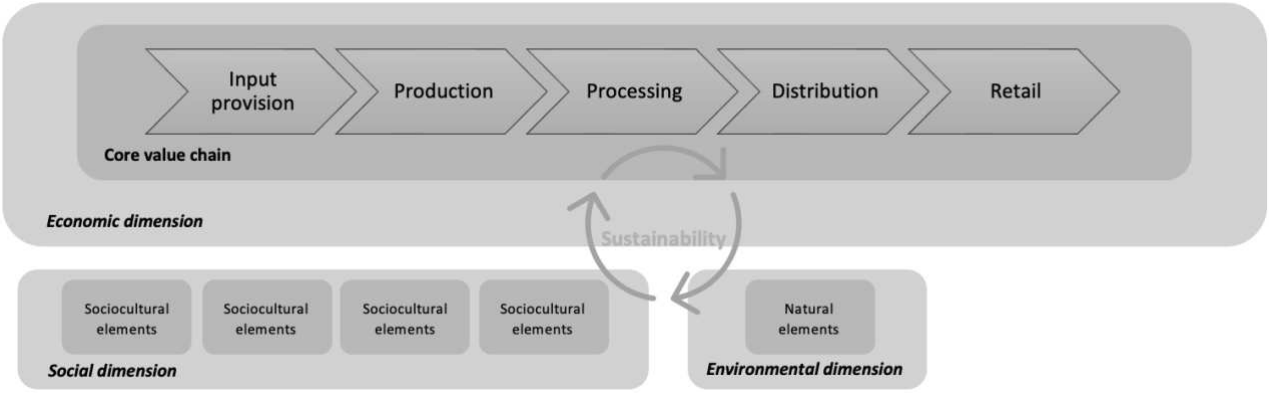
These studies all focus on the perception and attitudes of scholars, farmers, or consumers individually. Nonetheless, none of them create a more holistic understanding by connecting these different segments and including stakeholders involved in input provision, processing, transportation, and other related activities within the food value chain. To effectively address the present sustainability challenges, it is

crucial to comprehend the perceptions, interests, goals, and strategies of all actors within the food value chain. Therefore, this study aims to contribute to this research domain by bridging the gap between the perception of food value chain actors and experts regarding SFVCs and sustainability.

2.2. Sustainable food value chains (SFVCs)

There is a growing demand for sustainable, organic, local, and Fairtrade products, especially in developed countries, indicating a willingness of consumers and producers to favour alternative systems development (Paloviita, 2010; Petit, Bris, Trystram, & Lallmahomed, 2017). According to the FAO (2014; p.6) "a sustainable food value chain (SFVC) is defined as the full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society, and does not permanently deplete natural resources". The SFVC framework (see Figure 1) introduced by FAO (2014) identifies five core functions of the chain: input provision, production, processing, distribution, and retail.

Figure 1: Sustainable food value chain framework. Source: Own composition based on FAO (2014).



Sustainability within a food value chain should be achieved on the three dimensions of sustainability. Economic sustainability can be achieved by ensuring commercially viable activities for each actor that result in poverty reduction, higher incomes, job creation, etc. Environmental sustainability can be achieved by minimizing the negative environmental impacts of each link in the chain as a result of value-adding activities. Finally, social sustainability can be accomplished by ensuring socially and culturally acceptable outcomes in terms of the equitable distribution of the benefits and costs associated with value creation across the chain, age groups, gender, and society as a whole (FAO, 2014).

The discussion on SFVCs can be framed within the social-ecological system (SES), which connects different scientific disciplines, research, and practice (Andersson, et al., 2021). The SES can be defined as "a coherent system of biophysical and social factors that regularly interact in a resilient, sustained manner" (Redman, Grove, & Kuby, 2004, p. 163). In addition, it is a perpetually dynamic, complex system with hierarchical links, regulating the flow and use of critical resources across multiple scales (temporal, spatial, and organizational) (Redman, Grove, & Kuby, 2004). Recognizing and addressing the interconnections between social and ecological systems is crucial for effectively diagnosing and solving complicated sustainability challenges (Everard, 2020).

While the concept of socio-ecological systems (SESs) has been praised for facilitating interdisciplinary discussions, it has also faced criticism (Fabinyi, Evans, & Foale, 2014). Fabinyi et al. (2014) noted that a potential pitfall in attempting to bridge disciplines and develop a comprehensive understanding of human-environment relations is the possibility of overlooking social diversity, conflicting values, and power dynamics through a normative lens. In order to achieve resilience in the overall system, it is necessary to address the conflicting interests and aspirations of various stakeholders (Avriel-Avnia & Dick, 2019).

Everard (2020) explains that the three interconnected dimensions of sustainable development lie at the core of SESs. These dimensions - social, environmental, and economic - give rise to crucial inquiries regarding the involved stakeholders (who?), the aspects of ecosystems under consideration (what?), and the conceptualization of the overall economics of the SES (how?). However, it is equally important to consider these dimensions within the framework of formal and informal governance structures that shape decision-making processes, prompting the question of "why?" Additionally, the choices of technology and their impacts on the integrated SESs raise the question of "how?".

An extensive transformation of food systems can only be achieved if people change how they view and engage with food value chains while considering the socio-ecological systems surrounding them. Changing peoples' behaviour and perception towards (sustainable) food is often embedded in national and international strategies to promote SFVCs (Willett, et al., 2019). Therefore, this study aims to understand how food value chain actors comprehend sustainability in their field. This knowledge can then be used to improve the sustainability of food systems while respecting local knowledge and perspectives.

3. Method

The Q-methodology was developed in 1935 by psychologist William Stephenson and has been used in different fields. Over the last years, this methodology has gained popularity in sustainability and agricultural research (Barry & Proops, 1999; Curry, Barry, & McClenaghan, 2013; Wijaya & Offermans, 2019). The purpose of this method is to obtain individual perspectives on and attitudes towards a particular issue and analyse differences and similarities among individual views Amaruzaman, et al., 2017). Unlike a standard survey, the Q-methodology is designed to find patterns across individuals rather than across individual characteristics (e.g. gender, income, age, etc.) based on the ranking of statements. The Q-methodology attempts to analyse subjectivity in a statistically interpretable form by eliciting a variety of perceptions about or around a particular theme, such as sustainability and SFVCs (Barry & Proops, 1999).

Generally, it is assumed that there are not as many discourses as there are respondents, this assumption is also called 'finite diversity'. Therefore, with a limited number of respondents, this method allows the researcher to see if there are any patterns shared across individuals and attempts to reveal those in a structured and interpretable manner. This makes the Q-methodology particularly suited to study these contested and debated social phenomena since the method aims to elicit a range of voices, perceptions, and understandings (Barry & Proops, 1999).

The Q-methodology was selected as an appropriate scientific method to deal with the proposed research questions since it (1) balances the subjectivity of individual perspectives with the objectivity of statistical techniques; (2) is a flexible method that can be adapted to the research question, context, and capabilities of the respondents; (3) identifies perspectives among a group of individuals instead of identifying groups

of participants who share similar characteristics or behaviours; and (4) is well-suited when relying on a small number of respondents (Barry & Proops, 1999; Curry, Barry, & McClenaghan, 2013; Wijaya & Offermans, 2019).

The application of the Q-methodology in this paper is based on the example of the frequently cited publications by Barry and Proops (1999) and Curry, Barry, and McClenaghan (2013). These researchers also identified the most important steps involved in conducting Q-methodology research that was slightly adapted to fit the purpose of this research. The steps are discussed in detail below.

3.1. Step 1: Identification of the research topic

The research was conducted in Kenya for several reasons. First, it relies heavily on the agricultural sector. Their agricultural sector is the largest contributor to the economy, directly accounting for 26% of GDP and another 27% of GDP indirectly through linkages with other sectors (FAO, 2022). Second, the country is already enduring environmental fluctuations due to climate change (United Nations, 2022). Finally, Kenya has a fast-growing population that is expected to reach 81 million by 2030 at the current rate of growth (FAO, 2022). These three elements make SFVCs a necessity for the future, making Kenya a suitable location for this research.

More specifically, this research study was conducted in the Kisumu and Siaya counties. Kisumu is the third largest city in Kenya and is not centrally located, meaning that there is a substantial market for locally produced food (Omondi, 2018). Since this research focuses on short or local food value chains, Kisumu and Siaya counties were identified as interesting case studies. Research on the perception of local food value chain actors is limited yet important considering climate change and population growth. Moreover, Kenya is experiencing a nutrition transition with some evidence of changes in dietary habits although it is still unclear if more sustainable food is part of that transition (Holdsworth & Landais, 2019). These factors make the Kisumu and Siaya counties suitable for this research.

The Q-methodology does not require a large number of respondents, rather a carefully selected sample of respondents based on their comprehensiveness and diversity in perspectives (Wijaya & Offermans, 2019). The respondents are food value chain actors, specifically: input providers; farmers; distributors; intermediaries; extension officers; transporters; food processors; retailers; and consumers (Braun, Bitsch, & Häring, 2021; Kamrath, Wesana, Broring, & De Steur, 2019; Stein & Barron, 2017).

3.2. Step 2: Identification of key statements from the literature

The second step was to collect a set of statements covering all possible prevailing views on a certain topic (Hermans, Kok, Beers, & Veldkamp, 2012), which are SFVCs in this study. The primary source for the initial list of statements is published academic articles on sustainability, sustainable agriculture, and SFVCs.

Within this research a ‘structured Q-set’ was developed, meaning that the researcher breaks the relevant subject matter down into a series of themes or issues (Watts & Stenner, 2012). Since it is universally agreed upon that sustainability includes different dimensions, and following the example of Wijaya and Offermans (2019), the statements were divided into five categories: ‘economic’, ‘environmental’, and ‘social’ aspects, in combination with ‘general features’ and ‘responsible actors’. Still, one should note that some statements could belong to more than one category.

3.3. Step 3: Interviews with relevant stakeholders

After delineating the study area and collecting the initial list of statements, exploratory interviews were conducted. The interviews allowed for gathering more statements and getting insights from the respondents as to which statements should be used in the Q-sort. This approach was favoured to allow the research to focus on issues raised by participants, rather than researchers. The interviews were conducted face-to-face with five researchers, all linked to the field of agriculture and environment, at the Jaramogi Oginga Odinga University of Science and Technology (JOOUST) in March 2022 in Kisumu.

During the interviews, participants were asked what they considered important general, economic, environmental, and social features of SFVCs. Stakeholders were also asked which actors they thought were responsible for more sustainable food value chains. Lastly, they selected 30 statements from the initial list (statements were shown ad random) that they thought best described SFVCs. Each interview was recorded and transcribed with the permission of the interviewees. At the beginning of the interviews was agreed that no statements will be attributed to the individuals that made them.

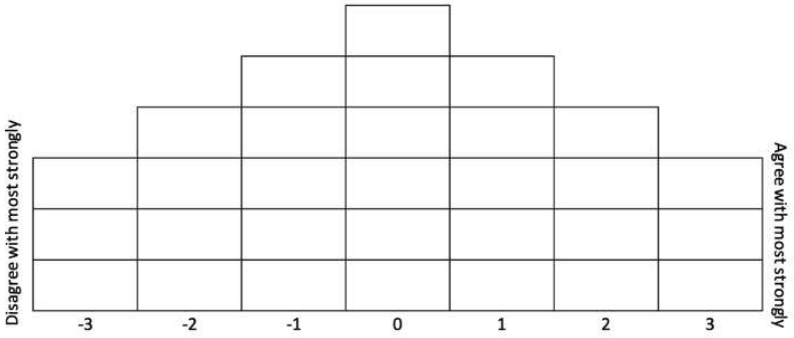
3.4. Step 4: Identifying the statements that will be used for the Q-sort

Based on the interviews, the initial list of statements was reduced. For this study, it was decided to limit the list of statements to 30 because it is easy to manage, both for the participant and the researchers, and it ensures that participants could sort the statements within a reasonable timeframe. The final list of statements is called the Q-sort.

3.5. Step 5: Respondent completion of Q-Sort exercises

Next, the respondents complete the exercise by sorting the Q-sort statements on the grid. The respondents were selected by snowball sampling and word of mouth, with the help of local researchers. First, the respondents were asked to carefully read all statements – which were printed on small cards – and then group them into three piles: the statements they agreed with, are neutral towards, and do not agree with. After structuring the statements, the respondents started ranking them on the normally distributed grid (see Figure 2) according to how strongly they agreed or disagreed. For this research a 'forced choice distribution' was chosen, meaning that respondents cannot deviate from the distribution that will be put forward. A seven-point scale (−3; −2; −1; 0; +1; +2; +3) will be used, where -3 corresponded to 'disagree with most strongly' and +3 to 'agree with most strongly'. The researchers communicated that all statements and sorting are relative to each other. For example, when a statement is ranked at -2, it does not mean that the respondent feels negative towards that statement, but that they agreed slightly less to that statement than the statement ranked at -1 or higher. Respondents are allowed to change the position of the statements during the exercise but cannot leave a blank space on the grid. The final set of ranked statements constitutes the 'Q-sort' for the respondent, which reflects the individual's perspective on the topic (Barry & Proops, 1999).

Figure 2: The Q-sort grid for each respondent. Source: Own composition based on Watt and Stenner (2012).



3.6. Step 6: Exit interview

Following the example of Wijaya and Offermans (2019), an exit interview was conducted after the respondents finalize the Q-sort exercise. More specifically, the respondents were asked to explain how they understand the concept of 'sustainability', 'climate change', and 'SFVCs' in their own words, and reflect upon the food-system-related issues in Kenya. This allowed verifying if the Q-sort statements sufficiently covered the diversity of perspectives on those concepts. Moreover, they were asked to explain why certain statements are positioned at the extremes and why they feel strongly about those statements. Statements that are ranked in a way that seems unusual for the researchers were further discussed with the respondent. Lastly, respondents were asked if they feel like statements were missing, and if so, which statements they would have added to the exercise. By asking these questions, the researchers obtained a better understanding of each Q-sort in more detail.

3.7. Step 7: Factor analysis of the Q-Sorts

The Q-sorts are analysed by means of a factor analysis, which was conducted using the free software programme KADE v1.2.1. This programme is specifically designed for Q-methodology data. All Q-sorts were uploaded into the software and the data was checked to determine if all Q-sorts could be used in the analysis. The calculations can also be done by hand following the guidelines of Watt and Stenner (2012). The first step entails creating a correlation matrix of the Q-sort data, which allows for the identification of strongly correlated statements. Next, the Eigenvalues need to be calculated. Eigenvalues are a measure of the variance in the data that is explained by each factor. The third step determines and extracts the appropriate number of factors based on a combination of conditions, which will be explained in detail in the 'Results' section. Lastly, the factors need to be interpreted in the context of the data and the research question.

3.8. Step 8: Interpretation of factor analysis results

When determining the factors, similar Q-sorts are grouped by factor analysis. To interpret what the viewpoint or perspective of each factor is, the researchers followed five steps (Derksen & Mithöfer, 2022; Watts & Stenner, 2012):

a) **Factor arrays interpretation to identify viewpoints:** Factor arrays are created by transforming the Z-score for each Q-sort into a single factor array. In other words, a factor array is a single Q-sort configurated to represent the viewpoint of a particular factor. This is done by placing the statements again on the grid, following the 'average' viewpoint of each factor. The three statements with the highest Z-score are found on the right side of the grid (+3), the four statements with the next highest Z-scores are found in the next column (+2), and so on until the statements with the lowest Z-score are positioned on the left side of the grid (- 3).

b) **Distinguishing significant statements**: The results of the factor analysis show which statements are significant for a specific factor and how they differ compared to the other factors.
c) **Creating 'crib sheets'**: Watts and Stenner (2012) recommend creating crib sheets to help deliver a holistic factor interpretation. For each factor, a crib sheet provides an overview of the statements that were positioned high or low within that factor and statements that were ranked lower or higher than in any other factor. This way it can be ensured that the major differences across factors are considered.
d) **Considering the exit interview**: All respondents were asked some additional questions after the Q-sort exercise was completed. These interviews allowed for gathering more detailed information on respondents' opinions and perceptions, which facilitates identifying differences between each viewpoint and the reasons for these differences.
e) **Demographic information**: Respondents' demographic information was also considered during the interpretation of the perspectives since it can support explaining or interpreting certain viewpoints.

4. Results

4.1. Results throughout the eight steps

When applying the Q-methodology, results are obtained throughout the process. As mentioned above, *Step 1* allowed to further determine the research question and area. *Step 2* focused on creating a list of statements. The majority of the statements came from nine academic papers and reports (Annunziata & Scarpato, 2014; Barry & Proops, 1999; FAO, 2016; FAO, 2022; Gannon, et al., 2022; Goswami, Saha, & Dasgupta, 2017; Gòmez, et al., 2011; Su, Tsai, Chen, & Lv, 2019; Wijaya & Offermans, 2019). Some statements were slightly modified to make them simpler, more precise, and suitable for this research without changing their meaning. This process generated 100 possible statements.

Step 3 allowed gathering input from the experts. It became clear which statements were prioritized and which were disregarded. In addition, after analysing the transcripts of the interviews five statements were added to the initial list of statements. Moreover, one of the respondents felt that the initial list of statements did not cover the 'governance' and/or 'policy' aspects well enough. Therefore, the statement on 'governance' was modified and a statement about the role of institutions was added to the final Q-sort.

Step 4 resulted in the final list of 30 statements (see Table 1). These statements were chosen for the Q-sort based on the selection and feedback from the experts. During the interviews, 15 statements were selected by three or more experts, 16 statements were selected by two experts, and 22 statements were selected by only one expert. The Q-sort consists mainly of statements that were chosen by two or more participants, except for one statement that was left out because its subject was already sufficiently covered by other statements. Moreover, the phrasing of each statement was carefully considered to avoid confusion amongst the respondents, making sure that the Q-sort broadly represents the existing opinions about the research topic, and that statements are not biased in favour of one particular opinion. Furthermore, it is a well-considered choice to limit the list to 30 statements because it is easy to manage, both for the participant and the researchers, and it ensures that participants could sort the statements within a reasonable timeframe.

Table 1: The Q-sort statements that were selected to be ranked by the respondents

#	Category	**Statements …** all starting with: 'sustainable food value chain(s) …'
1	**General**	… imply a balance between economic, social, and environmental values (profit, people, planet).

2	**Economic**	… actors can increase their profits through the adoption of environmentally sound practices.
3		… should focus in reducing post-harvest losses.
4		… can encourage actors to invest in water, soil, and energy conservation measures.
5		… can attract new actors to participate.
6		… support the development, transfer, and dissemination of environmentally sound practices.
7		… focus on improving efficiency of the value chain to reduce food prices.
8		… support inclusive economic growth.
9		… support higher levels of economic productivity through diversification, technological upgrading, or innovation.
10	**Environmental**	… prevent environmental degradation.
11		… are good for biodiversity.
12		… reduce the use of artificial fertilizers in agriculture.
13		… avoid that water elements become overly enriched with nutrients.
14		… reduce the pollution of the soil.
15		… reduce the use of herbicides and pesticides in agriculture.
16		… should minimise the carbon footprint (climate change mitigation).
17		… rely on resilient agricultural practices.
18		… imply the use of crop varieties or livestock breeds that are adapted to climate change.
19		… rely on agricultural heritage systems (local knowledge).
20	**Social**	… imply the consideration of local culture or values.
21		… do not exploit vulnerable groups (e.g. women, children, minorities, etc.).
22		… have broad-based benefits for society.
23		… should encourage effective partnerships (e.g. to share knowledge, resources, etc.).
24		… should increase food security.
25		… increase skills or promote lifelong learning opportunities.
26		… should support equal access to natural resources (e.g. land).
27		… imply the productive use of human resources.
28	**Responsible**	… are everyone's responsibility.
29	**actor(s)**	… need to be regulated by institutions.
30		… need governance to function.

In *step 5* respondents completed the exercise by ranking the Q-sort statements on the grid. For this research, it is important to involve different food value chain actors (see Table 2). Respondents were selected by snowball sampling and word of mouth, with the help of local researchers. In addition, to guarantee diversity and avoid an unduly homogeneous participant group, respondents from different ages and gender were included.

Table 2: Stakeholder descriptions

Stakeholder type	Description	Quantity
Farmer	The farmers in this study were small-scale farmers mostly involved in crop and vegetable production as well as livestock.	7
Transporter	Transporters are the people who buy products from farmers or processors and bring them to the market. They are responsible for the distribution of goods.	3
Processor	Food processors buy a product from farmers and process it (e.g. make yoghurt from milk).	3
Market vendor	Market vendors buy products (e.g. vegetables, fruits, milk, etc.) from farmers/middleman and sell them on organised outdoor or indoor market places.	5
Consumer	Consumers in this study could be anyone who regularly goes to a market or is responsible for cooking. Within this study, these respondents were not involved in the food value chain in any other way besides consuming and/or cooking.	4
Input provider	Input suppliers are individuals or agribusinesses that manufacture, distribute and/or sell inputs (e.g. seeds, pesticides, fertiliser, etc.) and equipment used in agricultural production.	1
Extension officer	Agricultural extension officers are intermediaries between researchers and farmers. They bring the knowledge from researchers to the farmers to facilitate their decision-making.	2
Researcher	The researchers in this sample were employed by universities or other (international) organizations. They were all involved in research regarding agriculture and food systems in general.	6

Note: Respondents were asked for their primary occupation. Several respondents with other primary occupations than farming were also involved in small-scale subsistence farming. Moreover, every respondent that is regularly involved in buying and/or cooking food can also be seen as a consumer. Yet, they will not be categorized as a consumer if their primary occupation falls within one of the other stakeholder types.

During the 'exit interviews' in *step 6,* more information on why statements were positioned in a certain way, was acquired. This information was also used in the construction and interpretation of the different perspectives. This brings us to *step 7*, the factor analysis. All Q-sorts were uploaded into the software and the data was checked to determine if all Q-sorts could be used in the analysis. The researchers noticed that three respondents (S5, M8, and S10) might have had difficulties understanding the assignment at the time of the Q-sort exercise. Therefore, the analysis was done with all of them, removing them one at a time, and removing all of them. Based on the changes in explained variance and Eigenvalues (EVs), it was decided to remove two Q-sorts (M8 and S10) from further analysis. Then, to determine the appropriate number of factors to extract, a combination of conditions was used. The first condition is that the EVs should be larger than one (i.e., the Kaiser-Guttman criterion). EVs indicate a factor's statistical strength and explanatory power. In this study, six factors had EVs larger than one. A second condition is the rule of thumb suggested by Watt and Stenner (2012). They suggest starting with one factor for every six to eight participants. In the case of this research, there were 31 participants, which means the appropriate number of factors will probably be between three and five factors. A third way to determine the appropriate number of factors is to look at the significance of the factor loadings. A third way to determine the appropriate number of factors is to look at the significance of the factor loadings. A factor should be extracted if two or more factor loadings, within the same factor, are significant. A significant factor loading at the 0.05 level can be calculated using the following equation (Brown, 1980, pp. 222-223):

$$\text{significant factor loading} = 1.96 \text{ x } \left(\frac{1}{\sqrt{no.\ of\ items\ in\ Q\ set\ (statements)}}\right)$$

$$= 1.96 \text{ x } \left(\frac{1}{\sqrt{30}}\right) = 0.359$$

A significant factor loading at 0.05 level is telling us that 95% of all Q-sorts would not come as close to the overall point of view of that particular factor. After careful consideration, four factors that complied with the criteria mentioned above were extracted and rotated. The Varimax rotation ensures that the extracted factors account for the maximum possible study variance. In the rotated factor matrix was checked which factors load significantly ($p<0.05$ significance level) on a single factor, which factors are confounded (load significantly on more than one factor), and which factors do not load significantly on any of the factors. The results are shown in Table 3.

Table 3: Factor-defining Q-sorts for the four study factors

FACTORS	Q-SORT IDENTIFICATION NUMBERS	TOTAL NUMBER OF Q-SORTS	CUMULATIVE TOTAL
1	18*; 10*; 26*; 31*; 7; 28	6	6
2	15*; 19*; 17*; 21*; 24*; 27; 8	7	13
3	3*; 20*; 29*; 25*; 14	5	18
4	11*; 1*; 5*; 9*; 22*	5	23
CONFOUNDED	12; 23; 30; 16	4	27
NON-SIGNIFICANT	4; 13; 6; 2	4	31

Note: Q sorts with a factor loading also significant at 0.01 are marked with an '*'. Confounded Q-sorts are not used in the construction of any of the factor estimates.

This brings us to the *eighth and final step*, the interpretation of factor analysis results. As discussed in the previous section, the researchers followed five steps (Derksen & Mithöfer, 2022; Watts & Stenner, 2012)**: (1) factor arrays interpretation to identify viewpoints** (see Figure S1 in the supplementary information (SI)**; (2) distinguishing significant statements** (see SI Table 2)**; (3) creating 'crib sheets'** (see Table 4 for an example and SI Table 3 for the other three crib sheets); **(4) considering the exit interview; (5) demographic information.**

Table 4: Exemplary crib sheet for Perspective/Factor 1

	ITEMS #	STATEMENTS	RANK
ITEMS RANKED AT + 3	9*	Sustainable food value chains support higher levels of economic productivity through diversification, technological upgrading, or innovation.	3
	16*	Sustainable food value chains should minimise the carbon footprint (climate change mitigation).	3
	8	Sustainable food value chains support inclusive economic growth.	3
ITEMS RANKED HIGHER IN FACTOR 1 ARRAY THAN IN OTHER FACTOR ARRAYS	12	Sustainable food value chains reduce the use of artificial fertilizers in agriculture.	1
	27*	Sustainable food value chains imply the productive use of human resources.	1
	15*	Sustainable food value chains reduce the use of herbicides and pesticides in agriculture.	0
	17*	Sustainable food value chains rely on climate resilient agricultural practices.	2
	26*	Sustainable food value chains should support equal access to natural resources (e.g. land).	-1
	13*	Sustainable food value chains avoid that water elements become overly enriched with nutrients.	0
ITEMS RANKED LOWER IN FACTOR 1 ARRAY THAN IN OTHER FACTOR ARRAYS	11	Sustainable food value chains are good for biodiversity.	-1
	5*	Sustainable food value chains can attract new actors to participate.	-2
	22	Sustainable food value chains have broad-based benefits for society.	-1
	18	Sustainable food value chains imply the use of crop varieties or livestock breeds that are adapted to climate change.	-2
	30*	Sustainable food value chains need governance to function.	-2
	28	Sustainable food value chains are everyone's responsibility.	-2
ITEMS RANKED AT -3	20*	Sustainable food value chains imply the consideration of local culture or values.	-3
	29	Sustainable food value chains need to be regulated by institutions.	-3
	19*	Sustainable food value chains rely on agricultural heritage systems (local knowledge).	-3

*Note: Items/statements with an equal or tied ranking in other factors are also included in the table. These include: #9 has the same ranking in Factor 4; #16 has the same ranking in Factor 3; #15 has the same ranking in Factor 3; #27 has the same ranking in Factor 2; #5 has the same ranking in Factor 3; #17 has the same ranking in Factor 3; #30 has the same ranking in Factor 3; #20 has the same ranking in Factor 4; #19 has the same ranking in Factor 4; #26 has the same ranking in Factor 2; #13 has the same ranking in Factor 3;

What follows is the interpretation of the extracted factors to sketch the underlying perspectives of each factor. The factors are discussed in a specific order, depending on the percentage of explained variance (14%, 12%, 7%, and 5% respectively).

4.2. Interpretation of the factors

Perspective 1 — Economic productivity and growth
The economic dimension before the environment, and the environment before the social dimension.

Respondents who share this perspective agree that sustainable food value chains should support inclusive economic growth (8; 3)[1] and economic productivity through diversification, technological upgrading, or innovation (9; 3). Based on the discussions with the respondents it became clear that

[1] The first number between the brackets refers to the statement number and the second to the rank of the statement.

(inclusive) economic growth is important for them to be able to increase their income and provide for their families, and eventually, the entire nation will benefit as well. Two respondents also explained that the food value chain can only become more sustainable by innovating and adopting technological applications and sharing this knowledge with others. In addition, they share the belief that a SFVC implies the productive use of human resources (27; 1). The Q-sorts that load significantly on this factor were all provided by male respondents with different professions and educational levels (from primary school to PhD). The implications can be multifaceted. On the one hand, it can portray a biased understanding of this perspective if no women are included in this factor, and on the other hand, it might also show that this perspective is male-dominated and rather an exception for women. Moreover, having male respondents from different professions and educational levels agree on the importance of these elements can provide a unique perspective on the challenges and opportunities faced by male actors in the food value chain.

It is clear that economic productivity and growth is the primary aspect of an SFVC according to this perspective. In the exit interview, respondents sharing this perspective also stressed the importance of profitable production, sustaining their businesses, and affording the tools, technologies, and products that they need for their businesses. Improving their standard of life was also a reoccurring message.

Respondents sharing this perspective state that their local heritage systems (19; -3), culture, and values (20; -3) can hamper innovation and technological adoption. Moreover, during the interviews, respondents explained that they attach great importance to their culture, but that it also has negative effects. Holding on to certain gender roles, local practices, and heritage systems can impede the adoption of new technologies and practices, although innovation is very important.

This viewpoint also considers environmental elements in sustainable food value chains. They believe that the carbon footprint (16; 3) should be minimised since it contributes to climate change, which is affecting agricultural production and in turn, the value chain as a whole (e.g. limited supply, rising food prices, hunger, etc.). Similarly, the use of artificial fertilizers (12; 1) and pesticides (15; 0) should be reduced since the chemicals will find their way into food products, eventually affecting people's health. Further, farmers should rely on climate-resilient agricultural practices (17; 2) and avoid eutrophication (13; 0). Although this perspective is not so much concerned with biodiversity (11; -1) nor with adopting climate-resilient crop varieties or livestock breeds (18; -2).

In addition, respondents sharing this viewpoint believe that food value chains do not need to be regulated by institutions (29; -3) or require governance (30; -2) to be more sustainable. Respondents sharing this perspective feel that people do not follow government regulations because they are too expensive or labour-intensive, and that regulations are often abused (e.g. bribing government officials to receive a certificate even if they did not follow the regulation). They also feel that people need to be able to make their own decisions without the interference of regulations and governance. In addition, they do not believe that increasing sustainability in food value chains is everyone's responsibility (28; -2) nor that SFVCs can have broad-based benefits for society (22; -1). Respondents argue that for food value chains to become more sustainable, farmers need to produce more sustainably, therefore, it is mostly the farmers' responsibility. Consequently, the benefits of increased and safe production will mostly go to the farmer and not to the whole of society. Still, equal access to natural resources (26; -1) is ranked higher than in most other perspectives.

Perspective 2 — Food security and food availability
The social dimension above the environmental and economic dimensions.

According to this perspective, the most important function of a SFVC should be to increase food security (24; 3) and reduce food prices (7; 3). Most respondents sharing this perspective feel like ensuring food security is (or should be) the main goal of a SFVC, which goes hand in hand with increasing the efficiency of the chain to reduce food prices. This was also reflected during the exit interviews, when asked how the respondents understood 'sustainability', half of the respondents in this group talked about sustaining their families and making sure there is enough food. Although the environmental dimension of sustainability is not prioritised, the respondents sharing this perspective do find it important that SFVCs can encourage actors to invest in water, soil, and energy conservation measures (4; 3).

This perspective emphasises the social aspects. SFVCs should create broad-based benefits for society (22; 2), are everyone's responsibility (28; 2), and should not exploit vulnerable groups (21; 1). Respondents explained that a food value chain can only be sustainable and function effectively if food value chain actors work together. A food value chain cannot rely solely on individuals, because there would not be enough production as the production would not get to the market, etc. Moreover, the exploitation of women is seen as an important issue. Respondents explained that women do not always have access to resources nor opportunities to work. Other social-economic elements that respondents agreed upon include: productively using the available human resources (21; 1), encouraging effective partnerships (23; 2), and attracting new actors to participate (5; 0). One respondent explained that it is important to establish partnerships, e.g. renting out land or sharing resources.

Additionally, this perspective includes that SFVCs should rely on agricultural heritage systems (local knowledge) (19; -1), and support equal access to natural resources (26; -1). Lastly, this viewpoint believes that governance is needed for SFVCs to function (30; 1). One respondent explained that currently, corruption within the Kenyan government is affecting the food value chain. Still, governance is needed to create infrastructure for SFVCs (e.g. roads, sheltered markets, etc.). The emphasises on food security and the social dimension of sustainability might be linked with the gender and occupation of respondents in this factor. Most are female (60%) and the occupations include: food vendors (4 out of 5 in the sample), consumers, farmers, a processor, and one transporter (who also is a food vendor as a secondary job). In Kenya, women are often the primary caregivers and decision-makers when it comes to food and nutrition within their families (Bikketi, Speranza, Bieri, Haller, & Wiesmann, 2016). As a result, they may be more vocal about changing prices, supply, and food availability. Overall, women having a greater concern for social sustainability in the food value chain is likely driven by a combination of their own experiences and social roles, as well as a broader recognition of the importance of social sustainability for building more equitable and resilient food systems.

Within this perspective, the respondents attach less importance to the economic and environmental dimensions of SFVCs. For instance, this perspective does not include reducing post-harvest losses to create a more sustainable value chain (3; -3) nor does this perspective attach importance to higher levels of economic productivity through diversification, technological upgrading, or innovation (9; 2). One respondent explained that according to him, post-harvest losses are not a common issue in the region. In addition, this perspective does not agree that food value chain actors can increase their profits through the adoption of environmentally sound practices (2; -1), that sustainable food value chains should rely on climate resilient agricultural practices (17; 0), should reduce the use of herbicides and pesticides (15; -2), prevent environmental degradation (10; -1), nor support the development, transfer, and dissemination of environmentally sound practices (6; -2). Two respondents explained that artificial

fertilisers and pesticides are necessary for production even though they are aware of the negative effects of the chemicals. Lastly, this perspective is not much concerned with minimising the carbon footprint (16; -3) nor avoiding eutrophication (13; -3). Concerning the carbon footprint, one respondent explained that food systems, and farmers in particular, do not pollute as much as people or businesses in the city. The respondent felt that reducing carbon emissions is not the responsibility of farmers and other food value chain actors. Two other respondents told the researchers that eutrophication is not a significant issue in the region, moreover, they mostly rely on rainwater for irrigation, so they are not affected by water bodies that are overly enriched with nutrients.

Perspective 3 — Environment first
Environment above the social dimension, and the social dimension above the economic dimension.

When respondents within the factor 'environment first' were asked to explain 'sustainability', nearly all of them talked about the environment and climate change. This focus on the environmental dimension is also reflected in how the respondents positioned the statements on the grid. Respondents sharing this perspective agreed that the carbon footprint should be minimised (16; 3), environmental degradation (10; 3) and soil pollution (14; 1) is prevented, biodiversity is preserved (11; 2), climate resilient agricultural practices are adopted (17; 2), crop varieties or livestock breeds that are adapted to climate change embraced (18; 3), the use of herbicides and pesticides are reduced (15; 0), and eutrophication is avoided (13; 0).

During the exit interview, the respondents further discussed their choices. They felt that preventing environmental degradation and soil pollution is important to sustain a certain level of production. This can be done by adopting climate-resilient practices and crop varieties or livestock breeds that are adapted to climate change. One respondent explained that adopting these practices is the only way to sustain production in the long run if it does not require additional input. Lastly, one respondent talked about how the chemicals used in agriculture are affecting biodiversity, and how a more sustainable way of producing might allow biodiversity to thrive, creating even more benefits for all.

Besides the environmental dimension of sustainability, some social elements are prioritised, such as avoiding the exploitation of vulnerable groups (21; 1), considering local culture, values (20; 0), and knowledge (19; -2). Others are disregarded, such as equal access to natural resources (28; -3), promotion of lifelong learning opportunities (25; -3), and the need for governance (30; -2). Respondents clarified that they believe equal access to natural resources is important, but they did not feel like it is or should be a key aspect of a SFVC. Similarly, respondents felt that a SFVC does not need governance or regulations, but that people should be intrinsically motivated to become more sustainable in their business or occupation. This way sustainability becomes a part of people's lifestyles and habits, allowing for the mindset to spread. Currently, governance and regulations are only limiting food value chain actors.

The economic side of sustainability is considered to a lesser extent. The respondents sharing this viewpoint do not believe that SFVCs should support inclusive economic growth (8; -3), increase food security (24; 1), assist the productive use of human resources (27; -1); attract new actors to participate (5; -2), reduce the use of artificial fertiliser (12; -1), focus on improving the efficiency of the value chain to reduce food prices (7; -1), encourage effective partnerships (23; -2), nor encourage actors to invest in water, soil, and energy conservation measures (4; -1). One respondent is convinced that SFVCs are not a guarantee for inclusive economic growth. In addition, another respondent explained that the first step

should be to make the food value chain more sustainable and afterwards prices can be negotiated. The efficiency of the chain should also be increased. Currently, there are too many losses between production and consumption (e.g. waste because of bad storage, bad-looking vegetables, or lack of refrigeration in the house).

The socio-economic characteristics of the respondents within this factor are diverse. The gender distribution is equal (50% male and 50% female), educational levels range between primary school and a master's degree, and the occupation of the respondents are distinct (e.g. farmer, transporter, processors, and researchers).

Perspective 4 — Transformative knowledge
Learning and innovation before the social dimension, and social dimension before the environment.

Respondents that share this fourth perspective associate 'sustainability' with availability of food, inputs, and knowledge. When they think about sustainability they think about empowerment through technological innovation and training. Another respondent explained that sustainability goes hand in hand with looking at the future, specifically, how to make sure that resources are not being depleted. To avoid the depletion of natural resources, technology and knowledge play a key role. This focus on innovation and learning is also reflected in the Q-sorts. Elements that are prioritized include boosting economic productivity through diversification, technological upgrading, or innovation (9; 3), improving the efficiency of the value chain to reduce food prices (7; 3), developing and disseminating environmentally sound practices (6; 3), and increasing skills and lifelong learning opportunities (15; 1). During the exit interviews the respondents explained that by continuing to learn, actors in the food value chain will innovate and increase productivity. Three respondents also specifically mentioned the importance of technological upgrading and transferring the technology and knowledge to the right people. This is especially important for farmers since by using technology and knowledge they can increase production and reduce food prices.

This focus on innovation and learning might be connected to the socio-economic characteristics of this group. When looking at the demographic characteristics of the respondents associated with this group (significant loaded Q-sorts), it is noticeable that all of them have at least a bachelor's degree (one person has a 'certificate degree').

The social dimension is also present in this perspective. Specifically, it is believed that SFVCs should have broad-based benefits for society (22; 2), are everyone's responsibility (28; 2), should attract new actors to participate (5; 0), and need to be regulated by institutions (29; 2). The broad-based benefits that are mentioned are mostly related to food security. If SFVCs increase efficiency and innovation, it will also increase food security and reduce the necessity of importing products, which in turn will benefit the local economy. Moreover, one respondent feels that it is everyone's responsibility to create SFVCs to ensure a future for the generations to come. Institutions can help to ensure this future but also to ensure food safety. However, respondents within this factor do not feel like SFVCs should avoid the exploitation of vulnerable groups (21; -2). The importance of the social dimension might be linked to the demographics of this factor since the majority (65%) is female.

Environmental factors are clearly pushed into the background. Respondents sharing this perspective do not think that SFVCs should reduce pollution of the soil (14; -2), the use of herbicides, pesticides (15; -2), and artificial fertilizers in agriculture (12; -1). They explained that to create a SFVC people need be able to sustain themselves and in order to do so, farmers need fertilizers and pesticides. Moreover, they

argue that pollution of the soil depends on the means of production and input and if people are informed and educated, pollution would not be an issue. Again, this shows the respondents' focus on learning and knowledge within this perspective.

In addition, they believe that SFVCs should not necessarily rely on climate-resilient agricultural practices (17; 0), avoid eutrophication (13; -3), increase food security (24; 1), nor encourage actors to invest in water, soil, and energy conservation measures (4; -1). However, they do find it important that post-harvest losses are reduced (3, 1), and actors can increase their profits through the adoption of environmentally sound practices (2; 2). One respondent argued that reducing post-harvest losses is essential to create more sustainable food value chains and if products are being wasted, they should serve for other purposes (e.g. animal feed, natural fertilizer, etc.)

Although the average age of the respondents associated with this factor is 51.5 years, which is significantly higher than the average age in the other three groups, it is remarkable that they emphasise that SFVCs should not rely on agricultural heritage systems (local knowledge) (19; -3) nor consider local culture or values (20; -3). When asked why local knowledge, culture, and values were not prioritized, respondents told the researchers that it is time to move on from local knowledge and culture since the surrounding circumstances are changing rapidly. Another respondent mentioned that local knowledge would never be enough to create a SFVC, but adopting technologies and innovations will contribute to creating SFVCs.

4.3. Commonalities between all factors/perspectives

Besides the four perspectives, the results of the Q-methodology revealed several other interesting findings. Firstly, some statements were consistently ranked relatively high by all four factors or perspectives. All perspectives agreed that SFVCs should support higher levels of economic productivity through diversification, technological upgrading, or innovation. This statement received a score of 2 or 3 within all four factor arrays. This suggests that economic considerations remain a priority for Kenyan food value chain actors, and they see innovation and diversification as essential to achieving sustainable economic growth. Similarly, all perspectives agreed that SFVCs should increase food security (ranked within all factor arrays between 1 and 3), indicating that food security is also an important consideration for all actors in the food value chain. The observed outcome can be reasonably explained by the current status of food security in Kenya, which has been characterized by recurrent food shortages and elevated levels of malnutrition. On the other hand, the adoption of climate-resilient agricultural practices was perceived to be moderately important for a more sustainable food value chain (ranked within all factor arrays between 0 and 2). This suggests that while actors recognize the importance of addressing climate change, they may not fully appreciate the potential impact of climate-resilient agricultural practices on food production and sustainability in general. Some statements also received positive rankings in three out of four factors, for instance: the importance of biodiversity, broad-based benefits for society, promoting lifelong learning opportunities, no exploitation, the efficiency of the chain, etc.

It is also worth noting that the statement 'SFVCs imply a balance between economic, social, and environmental values (profit, people, planet)' (1; 0) received the same rank within all factors. One possible explanation could be the relatively broad nature of this statement compared to the others. Nevertheless, this is the only statement that focuses on a balance between social, environmental, and economic elements, which might indicate that balancing these three dimensions is not a priority for Kenyan food value chain actors. All perspectives tend to be indifferent or neutral about reducing artificial fertilizers in agriculture and deploying human resources more productively to increase the

sustainability of food value chains. These two statements received scores between -1 and 1 within all factor arrays. During the exit interviews multiple respondents explained that if artificial fertilizers are used, it must be because it is necessary to sustain a certain level of production.

The results also reveal that the use of local knowledge or heritage systems in agriculture was disagreed with the most (ranked within all factor arrays between -1 and -3). This could be due to the perception that local knowledge may hinder innovation and development. However, it is important to note that indigenous knowledge systems can provide valuable insights into sustainable agricultural practices, and their incorporation into SFVCs could be crucial to achieving sustainability. Moreover, respondents mostly disagreed with the statement that specified that herbicide and pesticide use in agriculture should be reduced in SFVCs. This might be explained by a lack of knowledge about the negative effects of chemicals in agriculture or the perceived necessity to use those products to protect production. Lastly, respondents also did not agree (compared to other statements) that SFVCs can/should attract new actors to participate. Both statements received scores between 0 and -2 within all four perspectives. Some respondents explained that enough actors already participate in the food value chain, indicating a lack of interest in expanding the scope of SFVCs.

5. Discussion

This study revealed four stakeholders' perspectives regarding SFVCs. Creating a better understanding of the topic, especially in developing countries, might encourage the transition to more sustainable food systems. The result of this study confirms that the Kenyan food value chain actors are aware of the issues related to (un)sustainable food value chains and how climate change is impacting them. However, since this research is unique in terms of respondents, context, and methodology, it is challenging to compare it with related research. Still, some links can be made with previous studies. For instance, Szejda et al. (2021) found a broad acceptance of sustainable food among African consumers. Although the focus of this study is broader than only consumers, results showed that all food value chain actors are concerned with the sustainability of food systems. This study also shows that sustainability in food systems means different things to different people. While some prioritize protecting the environment, soil, and biodiversity, others understand sustainability as a result of knowledge, innovation, and technological upgrading. This finding is consistent with the findings of Owens and Legere (2015), Fifka et al. (2016), Aminpour et al. (2020), who all found that certain (groups of) people understand and define sustainability differently. Understanding these perspectives is crucial for research and policy making aiming at advancing global sustainability.

Research on African food value chain actors' perspectives on SFVCs has several implications for governments and local authorities. Firstly, it highlights the importance of considering the diverse perspectives of Kenyan actors within the food value chain when designing and implementing policies related to sustainability. Different actors may prioritize different aspects of sustainability, such as economic growth or environmental protection, and policy makers need to take these differences into account to ensure that policies are effective and inclusive. Secondly, understanding the diverse priorities of different Kenyan food value chain actors can improve communication and collaboration between stakeholders to achieve sustainability goals. Thirdly, the importance of innovation and knowledge-sharing in achieving SFVCs was highlighted in this study. Respondents who shared the 'transformative knowledge' perspective believed that innovation and knowledge can help address social and environmental issues in the food value chain. This suggests that policies and initiatives that support innovation and knowledge-sharing may be particularly effective in promoting sustainability.

6. Conclusion

Research on the perspectives of African food value chain actors regarding SFVCs and, more broadly, sustainability, seems to be scant compared with the relatively higher number of studies about this topic in developed countries. This paper contributes to filling this gap. By means of a Q-methodology, over 30 Kenyan food value chain actors shared their perspectives on SFVCs. The results confirm both similarities and differences in the perceptions that are held by the respondents in the counties of Kisumu and Siaya. The data were analysed by applying a factor analysis. The results allowed answering the first research question, 'How do African food value chain actors understand SFVCs?', by distinguishing four different perspectives: the 'economic productivity and growth', 'food security and food availability', 'environment first', and 'transformative knowledge' perspective.

Besides the differences between the four perspectives, some commonalities answered the second research question: 'Which are the most important characteristics of SFVCs according to African food value chain actors?'. According to all factors/perspectives SFVCs should ensure food security, support higher levels of economic productivity through diversification, technological upgrading, or innovation, and support the adoption of climate-resilient agricultural practices. Other statements most factors/perspectives agreed with included: the importance of biodiversity, broad-based benefits for society, promoting lifelong learning opportunities, no exploitation, the efficiency of the chain, etc. Statements that all perspectives disagreed with related to reducing pesticides in agriculture, attracting new actors, and building on local knowledge or heritage systems. Respondents generally argued that their use of pesticides is out of necessity. In addition, several respondents felt that local knowledge, culture, and values can hamper innovation and the adoption of sustainable practices, making it difficult to create SFVCs.

Furthermore, there are three limitations worth mentioning. First, the dependency on statement selection: the quality and relevance of the statements used in the Q-sort can significantly impact the study's outcomes. The selection process requires careful consideration and may still be influenced by the researchers and/or stakeholders' biases. Second, when conducting the interviews respondents sometimes struggled with conceptualizing and ranking the statements relative to each other. The researchers coped with these difficulties by giving additional information, explaining the exercise in different ways, giving examples, and asking questions to make sure the respondents understood what they needed to do. Lastly, when respondents were asked about the food value chain as a whole, some mainly focused on the production side, neglecting other segments of the chain. To ensure a comprehensive assessment of the food value chain, the researchers specifically prompted respondents during the interview to consider all segments involved, not just the production side.

Finally, the process and results of this study also revealed some opportunities for future research. Now that the priorities of food value chain actors are clear, further research could focus on how to improve those aspects and the food value chain as a whole. Further research could also determine whether the priorities of food value chain actors align with consumers' expectations. In addition, there are also methodological opportunities, for instance using the insights from a Q-methodology study in choice experiments. For instance, since the Q-methodology identified important aspects of the food system, those can be used as attributes in a choice experiment. Choice experiments serve to create an understanding of respondents' preferences and decision-making behaviour by presenting individuals with different alternatives and asking them to choose their preferred option.

Data Availability Statement

The datasets generated during and/or analysed during the current study are not publicly available due to privacy restrictions but can be made available from the corresponding author on reasonable request.

References

Curry, R., Barry, J., & McClenaghan, A. (2013). Northern Visions? Applying Q Methodology to Understand Stakeholder Views on the Environmental and Resource Dimensions of Sustainability. *Journal of Environmental Planning and Management, 56*, 624–649.

AGRA. (2016). *Africa agriculture status report 2016: Progress towards Agricultural Transformation in Africa.* Retrieved from Food and Agriculture Organization of the United Nations: http://www.fao.org/family-farming/detail/en/c/453715/

Ajayi, O. (2007). User Acceptability of Sustainable Soil Fertility Technologies: Lessons from Farmers' Knowledge, Attitude and Practice in Southern Africa. *Journal of Sustainable Agriculture, 30*, 21-40.

Akenji, L., & Bengtsson, M. (2014). Making sustainable consumption and production the core of sustainable development goals. *Sustainability, 6*, 513–529.

Amaruzaman, S., Leimona, B., van Noordwijk, M., & Lusiana, B. (2017). Discourses on the Performance Gap of Agriculture in a Green Economy: A Q-Methodology Study in Indonesia. *International Journal of Biodiversity Science, Ecosystem Services & Management, 13*, 233– 247.

Aminpour, P., Gray, S., Richardson, R., Singer, A., Castro-Diaz, L., Schaefer, M., . . . Chikowore, N. R. (2020). Perspectives of scholars on the nature of sustainability: a survey study. *International Journal of Sustainability in Higher Education, 21*, 1-20.

Andersson, E., Haase, D., Anderson, P., Cortinovis, C., Goodness, J., Kendal, D., . . . Wellmann, T. (2021). What are the traits of a social-ecological system: towards a framework in support of urban sustainability. *Urban Sustainability, 1:14*, 1-8.

Annunziata, A., & Scarpato, D. (2014). Factors affecting consumer attitudes towards food products with sustainable attributes. *Agricultural Economics, 60*, 353-363.

Anvar, M., & Venter, M. (2014). Attitudes and Purchase Behaviour of Green Products among Generation Y Consumers in South Africa. *Mediterranean Journal of Social Sciences, 5*, 183-194.

Avriel-Avnia, N., & Dick, J. (2019). Differing perceptions of socio-ecological systems: insights for future transdisciplinary research. *Advances in ecological research, 60*, 153-190.

Barry, J., & Proops, J. (1999). Seeking Sustainability Discourses with Q-Methodology. *Ecological Economics, 28*, 337–345.

Bikketi, E., Speranza, C., Bieri, S., Haller, T., & Wiesmann, U. (2016). Gendered division of labour and feminisation of responsibilities in Kenya; implications for development interventions. *Gender, Place & Culture, 23(10)*, 1432-1449.

Braun, C. L., Bitsch, V., & Häring, A. M. (2021). Behind the scenes of a learning agri-food value chain: lessons from action research. *Agriculture and Human Values*, 1-16.

Brown, S. (1980). Political subjectivity: applications of Q-methodology in political science. New Haven and London, UK: Yale University Press.

Byrch, C., Kearins, K., Milne, M., & Morgan, R. (2007). Sustainable "what"? A cognitive approach to understanding sustainable development. *Qualitative Research in Accounting & Management*, 26–52.

Derksen, D. M., & Mithöfer, D. (2022). Thinking sustainably? Identifying Stakeholders' positions toward corporate sustainability in floriculture with Q methodology. *Agricultural & Applied Economics Association*, 1–26.

Eurostat. (2020). *Sustainable development in the European Union: Monitoring report on progress towards the SDGs in an EU context.* Luxembourg: European Union.

Everard, M. (2020). Managing socio-ecological systems: who, what and how much? The case of the Banas river, Rajasthan, India. *Current Opinion in Environmental Sustainability, 44*, 16–25.

Fabinyi, M., Evans, L., & Foale, S. (2014). Social-ecological systems, social diversity, and power: insights from anthropology and political ecology. *Ecology and society, 19(4)*, 1-12.

FAO. (2013). *Climate-Smart Agriculture Sourcebook.* Rome, Italy: FAO.

FAO. (2014). *Developing sustainable food value chains – Guiding principles* . Rome, Italy: FAO.

FAO. (2016). *Developing gender-sensitive value chains.* Rome, Italy: FAO.

FAO. (2022). *Sustainable Food Value Chains Knowledge Platform*. Retrieved from FAO: https://www.fao.org/sustainable-food-value-chains/what-is-it/en/ (Accessed 21/01/2022)

FAO. (2022). *The agriculture sector in Kenya*. Retrieved from FAO: https://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/ (Accessed 14/02/2022)

Fifka, M., Kühn, A.-L., Adaui, C. R., & Stiglbauer, M. (2016). Promoting Development in Weak Institutional Environments: The Understanding and Transmission of Sustainability by NGOS in Latin America. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations, 27*, 1091-1122.

Gannon, K. E., Pettinotti, L., Conway, D., Surminski, S., Ndilanha, E., & Nyumba, T. (2022). Delivering the Sustainable Development Goals through development corridors in East Africa: A Q-Methodology approach to imagining development futures. *Environmental Science & Policy, 129*, 56-67.

Glasson, G. E., Mhango, N., Phiri, A., & Lanier, M. (2010). Sustainability Science Education in Africa: Negotiating indigenous ways of living with nature in the third space. *International Journal of Science Education, 32*, 125-141.

Godde, C., Mason-D'Croz, D., Mayberry, D., Thornton, P., & Herrero, M. (2021). Impacts of climate change on the livestock food supply chain; a review of the evidence. *Global Food Security, 28*, 1-17.

Goswami, R., Saha, S., & Dasgupta, P. (2017). Sustainability Assessment of Smallholder Farms in Developing Countries. *Agroecology and Sustainable Food Systems, 41*, 546-569.
Gòmez, M., Barrett, C., Buck, L., De Groote, H., Ferris, S., Gao, H., . . . Milste. (2011). Research Principles for Developing Country Food Value Chains. *Science, 332*, 1154-1155.
Hermans, F., Kok, K., Beers, P., & Veldkamp, T. (2012). Assessing sustainability perspectives in rural innovation projects using Q-methodology. *Sociologia Ruralis, 52*, 70–91.
Hoek, A. C., Malekpour, S., Ravena, R., Court, E., & Byrne, E. (2021). Towards environmentally sustainable food systems: decision-making factors in sustainable food production and consumption. *Sustainable Production and Consumption, 26*, 610–626.
Holdsworth, M., & Landais, E. (2019). Urban food environments in Africa: implications for policy and research. *Proceedings of the Nutrition Society, 78*, 513–525.
Kamrath, C., Wesana, J., Broring, S., & De Steur, H. (2019). What Do We Know About Chain Actors' Evaluation of New Food Technologies? A Systematic Review of Consumer and Farmer Studies. 798-816.
Kisaka-Lwayo, M., & Obi, A. (2014). Analysis of Production and Consumption of Organic Products in South Africa. In P. Vytautas, *Organic Agriculture Towards Sustainability* (pp. 24-50). Intechopen.
Liverpool-Tasie, L. S., Pummel, H., Tambo, J. A., Olabisi, L. S., & Osuntade, O. (2020). Perceptions and exposure to climate events along agricultural value chains: Evidence from Nigeria. *Journal of Environmental Management, 264*, 110430.
Luke, T. W. (2005). Neither sustainable nor development: reconsidering sustainability in development. *Sustainable Development, 13*, 228-238.
Makate, C., Makate, M., & Mango, N. (2017). Smallholder Farmers' Perceptions on Climate Change and the Use of Sustainable Agricultural Practices in the Chinyanja Triangle, Southern Africa. *Social Sciences, 6*, 1-14.
Marandure, T., Bennett, J., Dzama, K., Makombe, G., & Mapiye, C. (2021). Drivers of low-input farmers' perceptions of sustainable ruminant farming practices in the Eastern Cape Province, South Africa. *Environment, Development and Sustainability, 23*, 8405–8432.
Mazzocchi, F. (2020). A deeper meaning of sustainability: Insights from indigenous knowledge. *The Anthropocene Review, 7*, 77–93.
Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub- Saharan Africa. *International Journal of Agricultural Sustainability, 13*, 40-54.
Monastyrnaya, E., Bris, G. Y.-L., Yannou, B., & Petit, G. (2017). A template for sustainable food value chains. *International Food and Agribusiness Management Review, International Food and Agribusiness Management Association, 20*, 461-476.
Moraine, M., Grimaldi, J., Murgue, C., Duru, M., & Therond, O. (2016). Co-design and assessment of cropping systems for developing crop-livestock integration at the territory level. *Agricultural Systems, 147*, 87–97.
Munesue, Y., Masui, T., & Fushima, T. (2015). The effects of reducing food losses and food waste on global food insecurity, natural resources, and greenhouse gas emissions. *Environ Econ Policy Stud, 17*, 43–77.
Omondi, S. (2018). *Urban-Based Agriculture and Poultry Production: The Case of Kisumu and Thika in Kenya.* Sweden: Lund University.
Owens, K., & Legere, S. (2015). What do we say when we talk about sustainability? Analyzing faculty, staff and student definitions of sustainability at one American university. *International Journal of Sustainability in Higher Education, 16*, 367-384.
Pacho, F. (2020). What influences consumers to purchase organic food in developing countries? *British Food Journal, 122*, 3695-3709.
Paloviita, A. (2010). Consumers' Sustainability Perceptions of the Supply Chain of Locally Produced Food. *Sustainability, 2*, 1492-1509.
Parrott, N., Ssekyewa, C., Makunike, C., & Ntambi, S. (2006). *The World of Organic Agriculture. Statistics and Emerging Trends 2006.* Bonn: IFOAM.
Petit, G., Bris, G. Y.-L., Trystram, G., & Lallmahomed, A. (2017). Sustainability for the actors of a food value chain: how to cooperate? *International Journal of Sustainable Development and Planning, WIT Press, 12*, 1370-1382.
Pidgeon, N., & Fischhoff, B. (2011). The Role of Social and Decision Sciences in Communicating Uncertain Climate Risks. *Nature Climate Change, 1*, 35–41.
Pietsch, J., & McAllister, I. (2010). 'A Diabolical Challenge': Public Opinion and Climate Change Policy in Australia. *Environmental Politics, 19*, 217–236.
Purkis, M. (2020). Development of an Inclusive Value Chain for Peri-urban Micro-farmers. In R. Auerbach, *Organic food systems: meeting the needs of Southern Africa* (pp. 139-151). Boston, USA: CAB International.
Redman, C., Grove, M., & Kuby, L. (2004). Integrating social science into the Long Term Ecological Research (LTER) Network: social dimensions of ecological change and ecological dimensions of social change. *Ecosystems, 7*, 161-171.
Schiano, A., Harwood, W., Gerard, P., & Drake, M. (2020). Consumer perception of the sustainability of dairy products and plant-based dairy alternatives. *Journal of Dairy Science, 103*, 11228-11243.
SDG Center for Africa and Sustainable Development Solutions Network. (2019). *2019 Africa SDG Index and Dashboards Report.* Kigali and New York: SDG Center for Africa and Sustainable Development Solutions Network.
Slay, C., & Dooley, K. (2020, June 18). *Improving Supply Chain Resilience to Manage Climate Change Risks.* Retrieved from The Sustainability Consortium: https://www.sustainabilityconsortium.org/tsc-downloads/35952/ (last accessed 17/12/2021)

Stein, C., & Barron, J. (2017). *Mapping actors along value chains: integrating visual network research and participatory statistics into value chain analysis.* Colombo, Sri Lanka: International Water Management Institute (IWMI) and CGIAR Research Program on Water.

Su, C.-H., Tsai, C.-H., Chen, M.-H., & Lv, W. Q. (2019). U.S. Sustainable Food Market Generation Z Consumer Segments. *Sustainability, 11*, 1-14.

Szejda, K., Stumpe, M., Raal, L., & Tapscott, C. E. (2021). South African Consumer Adoption of Plant-Based and Cultivated Meat: A Segmentation Study. *Front. Sustainable Food Systems, 5*, 1-14.

The Global Environment Facility. (2020). *Resilient Food Systems: Programme highlights 2020.* GEF Partners.

UN. (1992). *Agenda 21: Programme of Action for Sustainable Development.* New York, USA: United Nations (UN).

UN. (2021, January 11). *World Population Prospects 2019*. Retrieved from United Nations: https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/947

UN. (2022). *The Sustainable Development Agenda* . Retrieved from The Sustainable Development Goals : https://www.un.org/sustainabledevelopment/development-agenda/ (Accessed 26/01/2022)

United Nations. (2012). *Report of the United Nations Conference on Sustainable Development.* Rio de Janeiro, Brazil: United Nations.

United Nations. (2022). *The Horn of Africa is Facing its Worst Drought in More than Four Decades.* UN Office for the Coordination of Humanitarian Affairs.

Vanhonacker, F., Van Loo, E. J., Gellynck, X., & Verbeke, W. (2013). Flemish consumer attitudes towards more sustainable food choices. *Appetite, 62*, 7-16.

Villholth, K. G. (2013). Groundwater irrigation for smallholders in Sub-Saharan Africa – a synthesis of current knowledge to guide sustainable outcomes. *Water International, 38*, 369-391.

Watts, S., & Stenner, P. (2012). Doing Q Methodological Research: Theory, Method and Interpretation. Los Angeles, USA: SAGE.

Whyte, P., & Lamberton, G. (2020). Conceptualising Sustainability Using a Cognitive Mapping Method. *Sustainability, 12*, 1-20.

Wijaya, A., & Offermans, A. (2019). Public agricultural extension workers as boundary workers: identifying sustainability perspectives in agriculture using Q-methodology. *The Journal of Agricultural Education and Extension, 25*, 3-24.

Willer, H., & Lernoud, J. (2019). *The World of Organic Agriculture: Statistics and Emerging Trends 2019.* Bonn, Germany: Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM - Organics International.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., . . . Murray, C. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet, 393*, 447-492.

Yang, Q., Shen, Y., Foster, T., & Hort, J. (2020). Measuring consumer emotional response and acceptance to sustainable food products. *Food Research International, 131*, 108992.