



XXIX International Scientific Conference

Strategic Managementand Decision Support Systems
in Strategic Management**SM2024**

Subotica (Serbia), 17-18 May, 2024

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APPROACHES TO MEASUREMENT SUSTAINABILITY OF AGRI-FOOD VALUE CHAINS

Abstract: Globalization combined with recent extreme events (Covid-19, wars, sanctions, climate changes) yielded additional challenges to sustainability of agri-food chains on national levels. Contemporary approaches to agri-food value chains (AFVC) should be evaluated. The goal in this paper is systematic review of AFVC literature in several dimensions: applied concept, focused value chain, used methods, location of studies and key findings. Based on this research prevailing concepts and research methods will be defined, as a first step in further researching an AFVC in Serbia.

Keywords: agri-food, sustainability, value chains

1. INTRODUCTION

The process of globalization in the food sector, through its history, generated an increasing effect on national AFVC levels. Although some are undeniably positive as: better food nutrition of world population, stability, and security of food supply worldwide, global increase in food production efficiency, etc. there are also opposite effects. One of negative sides of food globalization is high competitiveness pressure on national markets, sometimes with dumping prices, as result of strong export subsidies for excessive production from exporting countries. Farms and other companies in value chain increasing largely in size and makes AFVC fragile. National markets dependent on food or agricultural inputs import, facing Covid-19, wars or sanctions struggle with broken food supply, etc.

In recent decades, export bans introduced when nations were facing health or security issues, proved as a tool that hurts AFVC players. It was seen in case of: Ukraine, Russia, Serbia, and few other countries. With high stocks on the national market, prices of agricultural products fell below international level pushing farmers away from profit. In case of high inflation, food producers' and retailers' profits suffer from maximum prices introduced occasionally by the government for some basic food products.

Open markets are proven as more vulnerable and fragile in the case of AFVC. It is case with Serbia, participating in several free trade agreements. In recent decade Serbian farmers experienced strong price pressure especially in dairy and meat industry. Overproduction of agricultural and food products in some EU countries, in period of low international prices were subsidized in export. Very low prices were more than motivative for Serbian food importers. Consequently, the farm sector diminished livestock production to the level below self-sufficiency.

With such outside and sometimes inside pressures, AFVC on national level must improve their resilience to shocks. Institutional support in this process is essential. The first step, in deeper understanding of specific AFVC on national level, is making knowledge foundation from review of contemporary literature. The second step is to investigate and increase transparency, that will lead to the next step, better monitoring of AFVC.

2. METHODOLOGY

The research field encompasses an analysis of approaches to the sustainability of agro-food value chains (AFVC) at the national level, considering globalization and recent extreme events such as Covid-19, wars, sanctions, and climate changes. The methodology applied in this study is the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model as the methodological framework for the systematic review of literature on agro-industrial value chains. The first stage of the literature review involved selecting EBSCO Discovery Service and AgEcon Search as the primary source of information and determining key terms to aid in achieving the research goal.

The aim of the research is to develop conceptual framework from a systematic literature review of AFVC across various dimensions including applied concepts, focused value chains, utilized methods, study locations, and key findings. The search query applied was "AGRO FOOD VALUE CHAIN" AND "LITERATURE REVIEW." Keyword search was configured to cover titles, abstracts, and keywords in academic journals and e-books. Additionally, the search period was limited to documents published between 1990 and 2024, with only English language documents considered for the review process.

3. RESULTS

3.1. Concepts of value chain

The milestone in a concept of "value chain" created by Porter (1985), who defines it as a series of activities that a company undertakes to create value for the customer, starting from raw materials and extending to the delivery of the product or service to the end-user. The increasing focus on sustainability within the agricultural-food value chain necessitates precise analysis of concepts. To gain a better understanding and effectively track processes, it is crucial to have a deeper insight into the value chain.

A more detailed explanation, where the value chain describes the full spectrum of activities needed to bring a product or service from concept to final disposal after use, including different production phases (involving physical transformation and various producer services) and delivery to end consumers, was provided by Kaplinsky and Morris (2001). The concept of the value chain is widely understood, but it can be viewed from three perspectives. According to Da Silva, De Souza (2007) and Donovan et al. (2015), it can be seen as a series of activities that add value to a product from production to retail. Alternatively, it is viewed as a group of individuals or organizations linked along the chain, engaged in creating and modifying goods and services delivered to consumers. Thirdly, it is described as a strategic network of actors within the value chain collaborating within a broader institutional framework and utilizing support services. De Vries et al. (2022) define value chains as an integral part of strategic planning for many businesses today. The World Business Council for Sustainable Development (2011) defines a value chain as encompassing the entire life cycle of a product or process, including material sourcing, production, consumption, and disposal/recycling processes. In agriculture, a value chain identifies the set of actors and activities that bring a basic agricultural product from the field to final consumption, adding value at each stage of the production process. This value chain can take the form of a vertical link or a network among various independent business organizations involving processing, packaging, storage, transport, and distribution. The terms "value chain" and "supply chain" are often used interchangeably (World Trade Organization & OECD, 2013). The supply chain represents a network of organizations involved in various processes and activities that create value in the form of products or services directed towards the end user or consumer (Ballou, 2004). While the supply chain focuses on operational aspects of transportation and distribution, the value chain goes further by analyzing how each step in the process contributes to creating value for customers and the company as a whole.

3.2. Concepts of sustainability

Sustainability is the ability to maintain the balance of certain processes or conditions within a system. The most cited definition of sustainability and sustainable development, as set forth by the United Nations' Brundtland Commission (1987), is that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This definition was further expanded by 2005, encompassing the respect for environmental, social, and economic needs - the "three pillars" of sustainability. The interest in the sustainability of agricultural and food systems stems from environmental concerns that emerged in the 1950s and 1960s. However, ideas about sustainability date back to ancient times, to the earliest written records from China, Greece, and Rome (Pretty, 2008). This history underscores the continuity and significance of the sustainability concept across centuries and diverse cultures.

Sustainability in agriculture is a dynamic concept that encompasses ecological, social, economic, and resource aspects that may vary over time, location, society, and priorities. According to Wichaisri, Sopadang (2018), for businesses, sustainability is becoming a fundamental principle.

3.3. Sustainability of AFVC

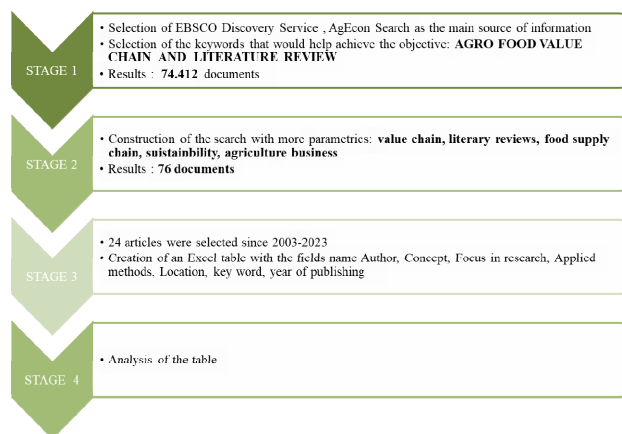
A sustainable food system (SFS) is a food system that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised (FAO, 2018). The concept of sustainable food value chains is defined as the complete range of farms and firms and their successive coordinated value-adding activities that produce specific raw agricultural materials and transform them into specific food products sold to end consumers and disposed of after use, in a manner that is profitable, has a wide range of societal benefits, and does not deplete natural resources permanently. According to Chouinard et al. (2011) the market is moving towards "demand-driven supply chains," so it is crucial to connect consumers not only with product design and retailing but also with the full impact of their choices. David (2014) highlighted that, unlike related concepts such as the supply chain, the concept of sustainable food value chains simultaneously emphasizes the importance of three elements. First, it recognizes that value chains are dynamic, market-driven systems in which vertical coordination (governance) is a central dimension. Second, the concept is applied broadly, typically covering an entire product subsector in the country (e.g., beef, corn, or salmon). Third, added value and sustainability are explicit, multidimensional performance indicators, assessed at the aggregated level. Food production faces multiple limiting factors for key resources such as land, water, energy, and inputs. We must use this challenge to stimulate creative innovations (Giovannucci et al. 2018)

The AFVC represents a complex network of activities and processes that enable the production, transformation, distribution, and marketing of food from agricultural producers to end consumers. Agro-value chains encompass activities that take place at various levels (farm, rural and urban), starting with input supply and continuing through product handling, processing, distribution, and recycling. As products move successively through the various stages, transactions take place between multiple chain actors, money and information are exchanged and value is progressively added (da Silva, de Souza, 2007).

3.4. Literature review

To conduct efficient research on the sustainability of agricultural value chains, a systematic approach was applied in selecting research methods and keywords for relevant literature search. Initially, general terms related to agricultural value chains were identified to encompass all relevant studies and documents. Subsequently, the term "sustainability" was included in the search to further focus the research on sustainability aspects in this context.

According to the presented search query in Picture 1, a total of 74,412 documents relevant to AFVC research were identified. Subsequently, using the additional search term "sustainability," 3,073 documents were identified to further refine the search. Additional terms such as "value chain," "literature reviews," "food supply chain" were included to narrow down the search. This led to a total of 167 documents. Further refinement with the addition of the term "agriculture" resulted in 76 works for this investigation. The systematic approach used for selecting methods and keywords facilitated the careful identification of relevant literature, enhancing the efficiency of analyzing information within the research domain of agricultural value chain sustainability.



Picture 1: Stages of the Methodology
Source: Authors, 2024

To facilitate analysis, a carefully crafted Excel table was created, encompassing key fields such as author, concept and theme, keywords, research focus, approaches, applied methods, location, and key findings. This structured framework not only systematically organizes data but also facilitates comprehensive examination of the various approaches applied in the analysis of works, ranging from quantitative and qualitative approaches to mixed methods.

Through detailed examination, it was established that works published in the last 20 years (2003-2023) are much more suitable for understanding contemporary approaches to agro-food value chains, while earlier works are more suitable

for theoretical postulates and the development of value chains in the agricultural and food sector. To gain a better understanding of the analysis approaches used in measuring the sustainability of agri-food value chains, we divided our research into two segments. The first segment involves an analysis of the methods used in review papers, while the second segment covers studies directly addressing all the challenges relevant to the sustainability of agri-food value chains. These two segments allow us to delve deeper into methodologies and specific research focusing on various aspects of sustainability in agri-food supply chains.

Table 1: Analysis of methodologies in review papers on sustainability of AFVC

Autor	year	Quantitative	Qualitative	Mixed
Donovan, et all	2015			11
Minarelli, et all	2016	2	3	
Rejeb, et all	2022	3	1	6
Misra and Mention	2022	8	9	12
Barbosa, et all	2022			38
de Vriesia, et all	2022	33	27	15

Source: Authors based on EBSCO and AgEcon Search, 2024.

During the period from 2015 to 2023, in six papers were conducted a systematic review of total 168 papers in the field of sustainability of agri-food value chains, considering range of research methods. The first step of analysis was to devide applied research methods in three groups: quantitative, qualitative, and mixed. The results indicate a diverse range of research methods utilized by authors, with a predominant use of mixed methodology. Out of the total reviewed papers, mixed research methods were utilized in 82 papers, identified among 5 groups of authors: Donovan et al. (2015), Rejeb, et all, Misra and Mention (2022), Barbosa, et all, and de Vriesia et al. (2022). Quantitative methods were employed in 46 papers, identified among 4 groups of authors: Minarelli et all (2016), Rejeb et al. (2022), Misra and Mention (2022), de Vriesia et al. (2022), while qualitative methods were used in 40 papers, identified by same 4 groups of authors. It is noteworthy that most papers were analyzed using a mixed methodology, indicating a trend among authors to adopt multidimensional approaches to study the sustainability of agri-food value chains. Such an approach enables a deeper understanding of the dynamics and interrelationships within value chains in the agricultural and food industries.

As second step of the analysis, the geographic distribution of research methods used in systematic reviews on the sustainability of AFVC reveals a significant geographical variation in research approaches in this field. The largest number of papers covering the geographical region of Europe utilized combined research methods, followed by Asia and North America. This conclusion suggests higher research activity and interest in the topic of sustainability of agri-food value chains in Europe, Asia, and North America compared to Africa and Australia. Potential reasons for this could include a higher number of research institutions and resources in these regions, as well as specific characteristics of the agricultural and food sectors that are the subject of sustainability research.

Table 2: Analysis of methodological approaches in studies addressing sustainability in AFVC

Author	year	Variables	Methods	Quantitative	Qualitative	Mixed
Cucagna, Goldsmith	2018	Value Added Measure EVA, MEVA, CEVA, PEVA.	ordinary last squares regression model, probit model	X		
Kurgat et al.	2018	improved irrigation,integrated soil fertility, organic manure and crop diversification.	A multivariate probit (MVP)	X		
Walder et all	2019	various types of innovation.	Negative Binomial Model, Circle of Basic Human Values, Poisson model			X
De Silva, Jayamaha, Garnevaska	2023	Initiatives for farmer development implemented by the buyer and sustainable performance of farmers (TBL outcomes for farmers).	conceptual research			X
Vrabcová P. Urbancová, H.	2023	the sector of an organization, the size of the organization by the number of employees, majority ownership, the type of organization and the annual turnover.	multivariate factor analysis, individual interviews			X
Akyüz, et all	2023	value added, net present value, internal rate of return, cash flows and cost of fixed assets, or break-even point, private and social prices of goods and services, consumer behavior, consumption decision-making process.	value added analysis, financial analysis, policy analysis matrix (PAM), and end market analysis			X
Benitez-Altuna	2024	engagement, adopting sustainable agricultural practices depending on the type of contract and relationship characteristics with buyers.	analysis of variance, logit modeling	X		

Source: Authors based on EBSCO and AgEcon Search, 2024.

According to the data from Table 2, the results indicate a wider application of quantitative and mixed methods in research on the sustainability of agri-food value chains, while qualitative methods were not used in the sample. The quantitative approach enables systematic collection, processing, and analysis of data to extract relevant information and draw well-founded conclusions. In this context, the sustainability of agricultural systems was investigated through the application of quantitative analysis methods in the works of Kurgat et al. (2018), Cucagna and Goldsmith, (2018) and Benitez-Altuna (2024). Kurgat et al. (2018) focused on enhancing agricultural production through the integration of various agro-technical approaches, including improved irrigation, soil fertility integration, organic fertilization, and crop diversification. This study used the quantitative method of multivariate probit regression to analyze the sustainability of rural and peri-urban vegetable farms, with a sample of 658 farms. Similarly, Benitez-Altuna (2024) explored the sustainability of agricultural practices through the analysis of farmers' engagement in promoting sustainable development. Quantitative methods of variance analysis and logistic modeling were used to examine the issue of farmer engagement under different contracts and relationship characteristics with buyers, with a sample of 352 farms participating in the study. Cucagna and Goldsmith (2018) applied ordinary last squares regression and probit models to panel data of financial information from a sample of 454 observations, focusing on value creation in agribusiness organizations.

Research on the sustainability of agricultural and food supply chains has encompassed a wide range of analytical methods to gain a comprehensive understanding of sustainability. The combination of quantitative and qualitative methods has allowed for a detailed examination of complex phenomena. For instance, Walder et al (2019) explored different innovations using Negative Binomial, Circle of Basic Human Values, and Poisson models on data from 174 farmers, providing deep insights into innovative practices and their impact on agricultural sustainability. De Silva, et al. (2023) delved into the economic, social, and environmental aspects of sustainability through the conceptual research by using initiatives for farmer development implemented by the buyer and sustainable performance of farmers (TBL

outcomes for farmers), while Vrabcová and Urbancová (2023) employed a mixed approach with factor analysis and qualitative research via focus groups, examining organizational characteristics and their impact on sustainability. Finally, Akyüz et al (2023) conducted a case study analyzing various sustainability aspects through value-added analysis, financial analyses, Policy Analysis Matrix (PAM), and market analyses, providing a comprehensive overview of sustainability implications in a study with 204 observations. This holistic approach of combining analytical methods has enabled a comprehensive understanding and the formulation of well-founded conclusions about the sustainability of AFVC.

The geographical analysis in the studies identified the origin of the works indicates a stronger research focus on sustainability in Europe compared to other continents, with Africa being the least represented. This highlights the importance of addressing regional disparities and enhancing global collaboration in research on the sustainability of agri-food value chains.

The topics analyzed include examination of value creation in AFVCs, identification of barriers to adopting sustainable agricultural practices, the role of government in supporting sustainable agriculture, dynamics of trust within agri-food value chains, the impact of the pandemic on the food industry and other economic sectors, as well as specific analyses of value chains for various product categories. Examining the most used keywords in this research, we find that four are prominent: Sustainability, Agriculture, Food, and Reviews, as illustrated in Figure 2.



Picture 2: Keywords cloud
Source: Author, 2024

4. CONCLUSION

This paper explored literature approaches to sustainability of AFVC in context of contemporary challenges. Since value chain concept was introduced, it has evolved, but recent challenges pushed researchers to understand AFVC in a new context. The basic assumption of the research is that globalization, while bringing certain positive aspects such as improved food nutrition, food supply stability, and increased efficiency in food production, also presents challenges such as highly competitive pressure in national markets and difficulties in food supply in case of external or internal pressures.

Through a systematic literature analysis focused on AFVC, 24 papers were identified in the period from 2015 to 2023. Of them, 17 papers relate to literature reviews, although only 6 counted research methods, and 7 that specifically contribute to the topic of AFVC sustainability. To summarize the findings, it can be concluded that a combination of quantitative and qualitative research methods, i.e. mixed methods, are gaining on importance recently. It is important, especially knowing that the use of qualitative methods was predominant during the last half of XX century in almost all economic research papers. This approach allows for a comprehensive analysis of data, integration of quantitative and qualitative insights, and provides a deeper understanding of complex phenomena in AFVCs. Quantitative methods enable a thorough analysis of data, while qualitative methods offer valuable context and insights into the dynamics of AFVCs.

In Serbia researchers focused on AFVC just in last several years. This field of research is still undiscovered, and identification of proper methodology will facilitate further research.

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