Article

Case Study Analysis on Agri-Food Value Chain: A Guideline-Based Approach

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Abstract: This study aims to identify the methods and associated indicators that are commonly used in value chain analyses (VCA) and to determine the areas of interest that have been excluded. Value chain analysis generally includes four different dimensions, which are institutional/functional, economic/financial, social, and environmental. This study has two main sources of literature. The first is the guidelines and the other is case studies on value chain analysis. The case study review is limited by the time between 2000 and 2022. The results showed that the researchers mainly focused on the institutional/functional analysis of the value chain, which is the first step of the analysis. Studies were mostly concentrated on the mapping of value chains, which includes the mapping of agents, core activities, and the marketing channels and flows of products. The second important area of interest is economic/financial analysis. Value added analysis is a top research area on the economical side of the value chain (VC). Consumer behavior and financial analysis are also included in the case studies. The research on consumer behavior of the value chain analysis has focused on the preferences, attitudes, and behaviors of the consumers. Financial analysis is another area of interest which generally concentrates on the cost of intermediate inputs, total output value, net present value, internal rate of return, cash flows and cost of fixed assets, and break-even point. The social and environmental sides of the value chain have been studied with less attention. This is much more important for a sustainable food VC.

Keywords: value chain analysis; modelling tools; indicators; guideline-based review; agent-based analysis

1. Introduction

The value chain is a high-level model of how businesses receive raw materials as input, add value to the raw materials through various processes, and sell finished products to customers [1]. It contains detailed information of the production process, starting from the initial production/producers to the end uses/users. It also has different types of agents in the markets, such as input suppliers, farmers, processors, wholesalers, retailers, and transporters. A value chain can be analyzed by mapping together the qualitative and

quantitative data [2]. The value chain guidelines elaborate the way of analysis that aims to measure how a value chain works and which tools are used for it [3–16].

Through this overview, this study provides an account of the main approaches and agri-food value chain guidelines in the literature on the role of agri-food value chain tools. It draws on multiple sources, including quantitative, qualitative, and case study-based data. Reviewed case studies also describe and quantify the modelling tools of the value chain and dimensions involved, depending on the objectives of the value chain analysis.

This paper also describes the various dimensions within systematic classification, such as institutional/functional, economic/financial, social, and environmental. Typically, these analyses are performed to include at least one dimension. These dimensions can be included separately or together in the analysis, depending on the objectives of the value chain analysis.

Thus, the major problem is to determine the dimension that is mainly focused on in the analysis of value chain, and to examine the modelling tools to find out different information on the production processes, investment planning, quality control schemes, price transmission, and product delivery channels.

The objective of this research is to identify the variables that should be used in value chain analysis; to identify the ones most commonly used by researchers; and to emphasize that the missing ones should be further studied for a sustainable value chain. This paper seeks to answer the question of whether value chain analysis can be performed using a four-dimensional approach.

The research hypothesis of this paper is "the social and environmental impact of the value chain is not sufficiently discussed in value chain analyses". In the concept of this hypothesis, this study provides an account of the main approaches and agri-food value chain guidelines in the literature on the role of agri-food value chain tools. It draws on multiple sources, including quantitative, qualitative, and case study-based data. Reviewed case studies also describe and quantify the modelling tools of the value chain and dimensions involved, depending on the objectives of value chain analysis.

In this study, 14 different guidelines which are generally accepted and widely used were reviewed and standardized with their tools and indicators/outputs; then the results of the more than 200 case studies were analyzed in this context [3–16]. These guidelines were developed by some well-known international organizations, such as the Food and Agriculture Organization of United Nations (FAO), the International Labor Organization (ILO), the United Nations Industrial Development Organization (UNIDO), the United States Agency of International Development (USAID), the International Institute for Environment and Development (IIED), and so on. Each organization has its own aim to analyze the value chains. For example, the FAO aims to develop sustainable food value chains and policy making; the ILO aims to develop value chains for decent works; the UNIDO aims to design value chains for agro-industry projects; Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) aims to develop a value chain with sustainable economic, environmental, social, and institutional criteria; and the IIED aims to develop an inclusive agri-food market for small scale farmers, etc.

In the analysis of the papers reviewed, it is seen that the economic/financial dimension is mostly included among the relevant dimensions in the analysis [3,4]. Each dimension also includes a wide range of tools and outcomes. Applying various modelling tools generates many different types of information on, for example, the production processes, investment planning, quality control schemes, price transmission, and product delivery channels. VCA can also seek answers to the questions of the contribution to economic growth, whether economic growth is inclusive, and whether the VC is socially sustainable and environmentally sustainable. From this perspective, the results of this study will be informative for researchers, institutions, and policy makers, especially those working on sustainable VCA by using the different types of indicators/outcomes.

A key finding of this study is that value chain analysis can be run into the four-dimensional approach. These are mostly depending on the guidelines' objectives, but

are generally focused on institutional/functional and economic/financial analysis of value chains.

In terms of structure, the study begins with an outline of the detailed information of value chain analysis. This section also briefly addresses the dimensions and reviewed guidelines. The second section considers the conceptual framework of value chain analysis, and assesses the corresponding dimensions required for the implementation of VCA. The third part outlines the materials and research methodology along with the methodological steps of the study. The other part reviews results on the guidelines of value chain analysis which are in the literature with the case studies. A conclusion is provided of the reviewed guidelines and case studies mainly focused on. A conclusion is also provided with some policy recommendations on sustainable food VCs.

2. Conceptual Framework of Value Chain Analysis

Value chain was stated first by Michael Porter in his book, "Competitive Advantage: Creating and Sustaining Superior Performance" [1]. He stated that a value chain is a set of activities performed by companies to generate value added for their customers. Value added is an adding of value by each activity, where the company has a competitive advantage by reducing their costs, which results in higher profitability.

Another conceptual study for value chain was done by Kaplinsky and Morris. These researchers explain the value chain as the activities required to deliver a product or service to final consumers through different processes, and to dispose of the product after its use. Differently, it is recognized that it is formed when all actors operate in a way that maximizes value production along the chain [17,18]. The definitions can be explained narrowly or broadly, as presented below.

In the narrow definition, the value chain concentrates on a single firm. In this approach, the value chain covers the framework and design phase; input procurement; production, marketing and distribution; and performance of after-sales services.

Broadly defined, a value chain consists of the activities carried out by various intermediaries (from producers to service providers), from a raw material until the final product sale. In this approach, the value chain begins from the production of raw materials and continues in connection with the enterprises that perform activities, such as trade, different processing activities, etc.

Value chain activities can be divided into primary and supportive activities. Primary activities are production, logistics, processing, and marketing. Supportive activities support the primary activities and each other by providing purchased inputs, technology, human resources, and various firm-wide functions [1].

There are four generic categories of primary activities involved:

❖ Logistics: the activities on receiving, storing and disseminating inputs to the product, and the activities on collecting, storing, and distribution to buyers;
❖ Processing: the activities on transforming inputs into the final product form, such as packaging, assemblage, maintenance of fixed assets;
❖ Marketing and Sales: the activities on the buyers purchasing the product and increasing sales;
❖ Service: the activities on providing services to maintain the value of the product.

There are four generic categories of supportive activities involved:

❖ Procurement: this refers to purchasing inputs, such as raw materials, consumable items, and assets of inventory;
❖ Technology Development: the use of technology and technology development;
❖ Human Resource Management: these are recruiting, hiring, training, and development of all types of personnel;
❖ Firm Infrastructures: this is the number of activities on planning, financing, accounting, legal affairs, relations with government, and quality management.

Agri-food value chains make a major contribution to agricultural development by creating added value and employment. In doing so, they help to produce policies that allocate resources to the most efficient sectors and products. They provide an operational framework for engaging farmers, businesses, and policy makers to improve income generation [16].

Value chain analysis can be run into the four-dimensional approach. Of course, these are mostly depending on the guidelines' objectives, but are varying generally on the institutional/functional and the economic/financial analysis of value chains. Some minority of them can observe the activities on the basis of social and environmental awareness. Hence, this study will be consisting of an approach with the four dimensions of the value chain analysis—institutional/functional, economic/financial, social, and environmental evaluation.

2.1. Institutional/Functional Analysis of the Value Chain

The objective of the institutional/functional analysis is to describe the value chain system in general. This analysis depicts the main agents and details their challenges. Key elements include the identification of the agent, the sub-chains, and the geographical and time frames that underpin all analyses to answer the framing questions. The key segments of the value chain can be listed as follows: the product line, the agents involved, the functions they perform, the flows to agents, and the entire organizational framework and governance of the VC. Institutional/Functional analysis produces different data on products, stages and process of the value chain, the agents and their features, input providers, flow of product and services, volumes, the organizational framework, and types of governance, business environment, policies implemented, current state of the market, and the importance of value chain for the agents and for the country [16].

2.2. Economic/Financial Analysis of Value Chain

Economic/Financial analysis is carried out to explain and measure the sustainability and profitability of all agents and activities. The main objective of this analysis is to demonstrate the contribution of the economic impact of the value chain on growth and income distribution. This analysis also provides information on competitiveness within the global economy (Figure 1).
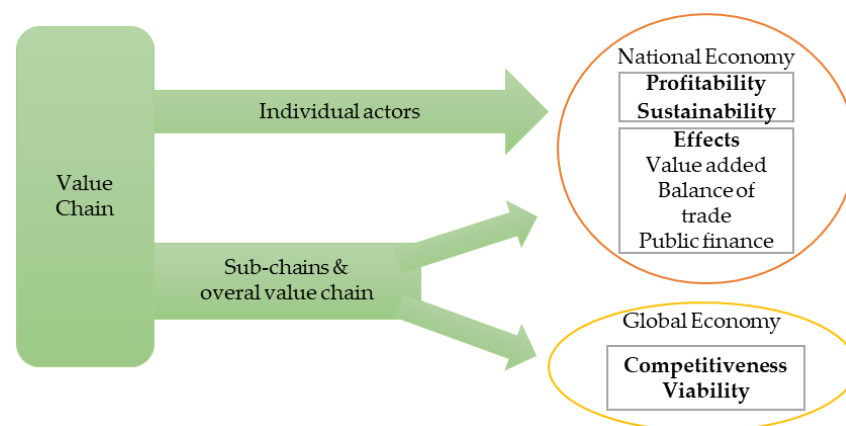

Figure 1. Economic Analysis of Value Chain [16].

Economic/Financial analysis produces the modelling data on price transmission, investment planning, production process, consumption patterns, and some others.

These data are mainly on value added analysis, financial analysis, policy analysis matrix (PAM), and end market analysis. Value added analysis assesses, in quantitative terms, the creation of "value added" and its distribution to the various agents and activities involved along the value chain. Financial analysis provides data on investment planning by using a ratio-analysis such as net present value, internal rate of return, cash flows and cost of fixed assets, or break-even point [8]. Policy analysis matrix (PAM) is a method

of analysis that reveals the consequences of government intervention in the economy by using the private and social prices of goods and services [13]. End-market analysis is an analysis which concentrates on consumer behavior. This is the psychographic analysis which identifies the factors influencing the consumption decision-making process [15].

2.3. Social Analysis of Value Chain

Social analysis is concentrated on two parts. First is the social inclusiveness of the value chain. The first part of the analysis looks at stakeholder identification and the distribution of income and employment across social groups by VC organization and governance. It examines the impacts of the value chain on vulnerable groups, such as landless farmers, smallholders, women, youth, seasonal workers, and marginalized people (Figure 2).

Figure 2. Social Inclusiveness of the Value Chain [16].

The second part is social sustainability. The analysis of the social sustainability of the value chain takes place by examining six different issues. These are the state of working conditions, the state of land and water rights, the outlook for gender equality, food and nutrition security, social capital, and living conditions [16].

2.4. Environmental Analysis of Value Chain

Environmental analysis of the value chain is mainly concerned with resource depletion, ecosystem quality, climate change, and biodiversity. The environmental sustainability of the value chain is explained by evaluating the data collected on the above-mentioned issues [16]. The assessment of the environmental sustainability of the value chain is carried out in two stages; a life cycle analysis based on quantitative data, and an assessment of biodiversity risks (Figure 3). The loss of biodiversity is affected by two main sources; value chain activities and landscape interventions.
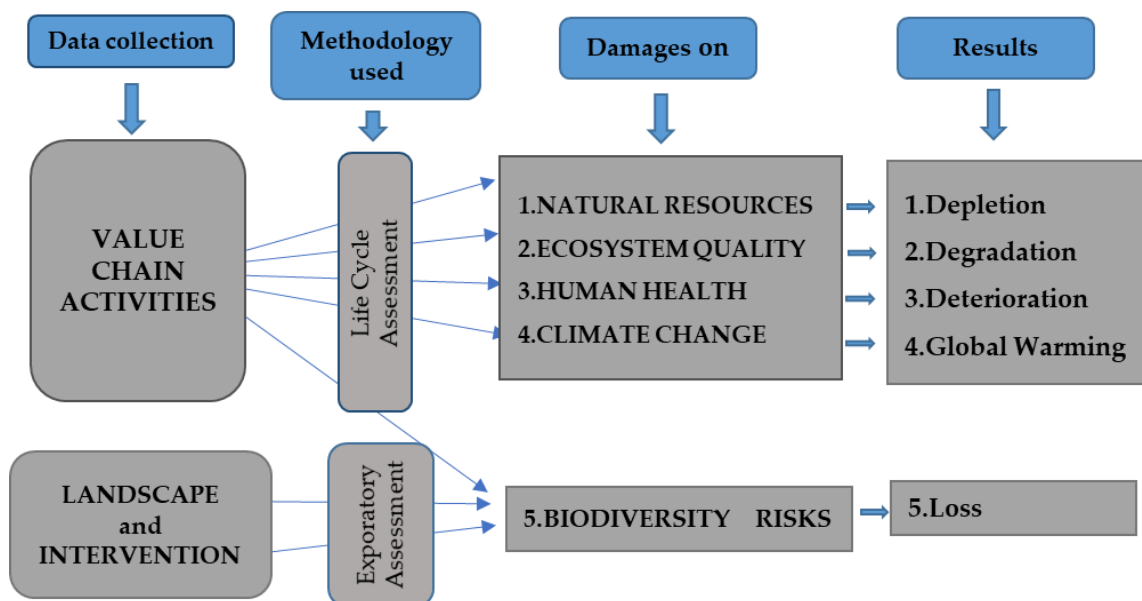

Figure 3. Environmental Assessment of Value Chain [16].

3. Materials and Research Methodology

The material of this study consists of two types of secondary sources: the guidelines which are developed by public authorities or non-governmental organizations through development projects, and scientific papers based on the case studies of agri-food value chain analysis. A two-phase review was conducted using a guideline-based approach with a research team.

In order to identify and review the concept of "agri-food value chain tools", we proceed first with the theoretical information, including some important guidelines of value chain analysis (Table 1). The guidelines were used to produce data on the tools/methodologies/practical approaches of value chain analysis, and the indicators/outcomes could be used for each related tool, where each one has some specific objectives. It is called a guideline-based review.

Table 1. Reviewed Guidelines on Value Chain Analysis.

The Guidelines
1. ILO-Value Chain Development for Decent Work (2021) [4]
2. VCA4D: Value Chain Analysis for Development (2018) [16]
3. ACIAR-Australian Center for International Agricultural Research (2016) [15]
4. GIZ-Guidelines for Value Chain Selection (2016) [3]
5. FAO-Developing sustainable food value chains (2014) [14]
6. FAO-VC Analysis for Policy Making (2013) [13]
7. UNIDO-United Nations Industrial Development Organization (2011) [12]
8. IIED-International Institute for Environment and Development (2008) [10]
9. M4P-Making VCs Work Better for the Poor (2008) [8]
10. USAID-United State Agency International Development (2008) [9]
11. GFU-Promoting Value Chains of Neglected and Underutilized Species (2008) [11]
12. CIAT-International Center for Tropical Agriculture (2007) [6]
13. FAO-Rapid Appraisals (2007) [7]
14. CIP-International Potato Center (2006) [5]

The second step was to review case studies of agri-food value chains. All studies (204 case studies) that were evaluated also considered case studies. This was done by searching the databases Scopus, Web of Science, and EBSCO. The search was filtered by publication date not later than 2000; fields in business, economics, agriculture; and subjected to "agri-food value chain", "agri-food value chain analysis" on several product groups, such as cereals, fruit and permanent crops, vegetables, legumes, tubers and oily crops, in peer-reviewed journal papers. All case studies obtained after filtering were included in the scope of the study and evaluated with a questionnaire form created using guidelines. In this frame, 204 cases were surveyed by the methodological steps of the study, which is shown in Figure 4.
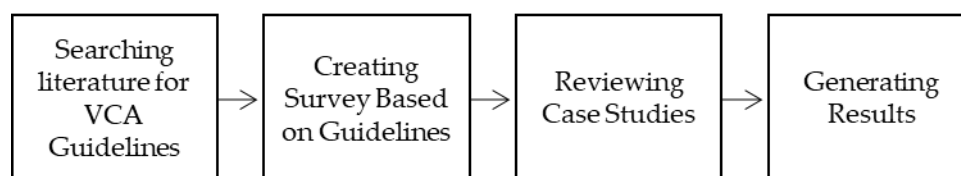

Figure 4. The methodology of the study.

4. Review Results on Guidelines of Value Chain Analysis

There are different guides (also known as handbooks) on value chain analysis. Nang'ole, E.M. et al. (2011) reviewed several guides used in value chain analysis. Their work includes similarities and differences in value chain and other similar terms. The study describes four stages of value chain analysis. These are assessment, design, implementation, monitoring and evaluation [19].

J. Donovan et al. (2015) reviewed 11 guidelines for value chain development. They reviewed the current guidelines on the basis of VC objectives and motivations, VC definitions, methodological design of VC, data collection and analysis, assessing and monitoring outcomes, and impacts [20].

P.M., Clay and R., Feeney (2019) conducted a literature review on agri-food value chain analysis. Their study consists of two parts. The first part examines the concept of value chain, how the concept of value chain has changed over time, and how the narrow definition of value chain can be. The second part examines the current methodological techniques used in value chain analysis in the agri-food sector [21].

In recent years, governments and non-governmental organizations have shown much interest in value chain analysis to combat rural poverty and manage economic development. There has therefore been an increase in "guidelines development". In this study, first step was to examine fourteen well-known and widely-used guidelines. All investigated guidelines have been reviewed on the basis of tools used, which means the areas of interest of VC analysis and the produced outcomes in each related tool.

In Table 2, the guidelines are given with the dimension they focused on for value chain analysis, and the main approach used. All these guidelines are developed by different institutes and tested for different countries and crops. The guidelines included here are broad enough to provide a strong indication of the overall state of the art. All guidelines followed either an activity-based approach or an agent-based approach, or both. Activity-based VC analysis is based on all related main and supportive activities in the VC—from the first step to the end market—such as input provision, cultivation, collection, production, marketing and distribution, and consumption. Agent-based VC analysis is based on the individual or institutional actors dealing with the activities done along the VC, such as farmers, collectors, processors, wholesaler, retailer, and consumers.

Table 2. The dimensions focused on by the reviewed value chain analysis guidelines.

Value Chain Analysis Guideline (Sorted by Year Descending)	Institutional/ Functional	Economic/ Financial	Social	Environmental
1. ILO-Value Chain Development for Decent Work. A systems approach to creating more and better jobs *		✓	✓	
2. VCA4D-Value Chain Analysis for Development (VCA4D), Methodological Brief. Frame and Tools, key features of experts' work *	✓	✓	✓	✓
3. ACIAR-A Guide to value chain analysis and development for overseas development assistance projects ***	✓	✓	✓	✓
4. GIZ-Guidelines for Value Chain Selection: Integrating economic, environmental, social and institutional criteria **	✓	✓	✓	✓
5. FAO-Developing sustainable food value chains-Guiding principles ***	✓	✓	✓	✓
6. FAO-Value Chain Analysis for Policy Making, Methodological Guidelines and country cases for a Quantitative Approach ***	✓	✓		
7. UNIDO-Pro-poor Value Chain Development: 25 guiding questions for designing and implementing agroindustry projects ***	✓		✓	
8. IIED-Chain-wide learning for inclusive agri-food market development: a guide to multi-stakeholder processes for linking small-scale producers with modern markets **	✓			
9. M4P-Making Value Chains Work Better for the Poor: A Toolbook for Practitioners of Value Chain Analysis *	✓	✓	✓	
10. USAID-End market research toolkit: Upgrading value chain competitiveness with informed choice ***	✓	✓		

Table 2. *Cont.*

Value Chain Analysis Guideline (Sorted by Year Descending)	Institutional/ Functional	Economic/ Financial	Social	Environmental
11. GFU-Promoting Value Chains of Neglected and Underutilized Species for Pro-poor Growth and Biodiversity Conservation, Guidelines and Good Practices ***	✓	✓	✓	
12. CIAT-Participatory Market Chain Analysis for Smallholder Producers *	✓			
13. FAO-Guidelines for rapid appraisals of agri-food chain performance in developing countries ***	✓			
14. CIP-Participatory market chain approach (PMCA)-user guide ***	✓	✓		

* Both activity-based and action-based approaches are used. ** Only agent-based approach is used. *** Only action-based approach is used.

Based on our guideline review, we identified the value chain analysis tools and the respective indicators/outcomes associated with each of the four dimensions used in value chain analysis. We then used these tools and indicators/outcomes to analyze the agri-food case studies.

4.1. Institutional/Functional Analysis

Institutional/Functional analysis profiles the industry by describing, explaining, and measuring different aspects in physical terms. In this analysis, the industry is considered from the following perspectives: commodity production, processing, marketing, and final consumption. In detail, it examines: (a) technical processes required from production/producer to final consumption/consumer; (b) the inputs and intermediate goods at each stage of the value chain; (c) the interrelationships between the agents/actors involved at each stage; (d) the physical flows of goods between different agents/actors; and (e) problems in input supply, logistics, etc. This is called mapping in general, and others come behind the mapping; governance analysis, demand and supply conditions, SWOT analysis, and end market analysis. Each one of them has some specific data produced on the production process and up-down streams of value chains, quality control schemes, price transmissions: vertical and horizontal, product delivery channels, investment planning, cultivations and consumption patterns of the entire value chain (Table 3).

Table 3. The tools and the respective indicators/outcomes of institutional/functional analysis.

Tool	Indicators/Outcomes	Data Produced On
Mapping (VC Elements Analysis)	(1) Functional analysis table (2) Mapping of core process (3) Mapping of agents (4) Mapping flows of products (5) Marketing channels (6) Volume of inputs/outputs (7) Mapping knowledge and flow of information (8) Mapping the volume of product, number of agents and jobs (9) Mapping the value at different level of the value chain (10) Mapping the relations and linkages and trust (11) Mapping constraints and potential solutions (12) Knowledge and technology matrix (13) Matrix of market channel analysis	Production process: Core process, agents, marketing channels, product- information- money flows, Volume/share of products flows Product delivery channels: Flows of product, marketing channels Cultivation pattern: Flows of inputs, flows of products, marketing channels

Table 3. *Cont.*

Tool	Indicators/Outcomes	Data Produced On
Governance Analysis	(1) Matrix of rules and standards and regulations (2) Matrix of regulations and agents (3) Quality standards (4) Rewards and sanctions (5) Access to market, technologies, finance, skills and knowledge (6) Vertical-horizontal integration (7) List of constraints (and type of constraints) (8) List (and type) of relevant economic support programs running and planned for (9) Certification/ labelling	Quality control: Rules, standards and regulations, certification and labelling Investment planning: Rewards and sanctions, economic supports
Demand and Supply Conditions	(1) Area sown, yields, number of farmers (time series) (2) Quantity of supply and demand (time series) (3) Export and import (time series) (4) Prices (national market, international) (time series) (5) Supply utilization account (time series) (6) Share (%) of product/sector in gross domestic production (GDP) and export value	Price transmission: International and national prices Cultivation and consumption pattern: Quantity of supply and demand for different type of products
SWOT Analysis	(1) Strengths of VC (2) Weaknesses of VC (3) Opportunities of VC (4) Threats of VC	-
End Market Analysis (Market Research/Phase 1)	(1) National market (2) International market (Import-Export)	-

Source: this table is modified by the authors based on reviewed guidelines (see Table 2).

4.2. Economic/Financial Analysis

An economic analysis of the value chain is an analysis of the value added created, and its distribution among different agents/actors, with quantitative data. Value added is a measure of the welfare created by net resource utilization in an economic system. More precisely, economic analysis is an area of analysis that generates crucial information for analysts: (a) on the amount of value added created for the whole value chain; (b) on the level of value added created for each agent; (c) on the distribution of value added among the factors of production and the allocation of value added to different areas such as profits, wages, rents and taxes; and (d) in providing the information needed to decide on investment planning. Financial analysis can be ensured by the value added data resulted. Another tool is to prepare a policy analysis matrix (PAM). The fourth tool (end market analysis) is a very important part of the VC analysis containing some explanatory data on consumer behavior. An economic/financial analysis of value chains produces many different data on investment planning to existing and prospective investors, and cultivation and consumption patterns of farmers and consumers in the community (Table 4).

4.3. Social Analysis

Social analysis of value chains is a field of analysis that examines and generates information on the contribution of a value chain to the income, expenditure and social status of different social groups. This analysis also examines the geographical impact of the value chain, the role of the value chain in local production systems, rural-urban relations and regional development practices. This analysis is consisting of the elements of employment creation, gender analysis and gender equality and decent work deficit evaluation. Social analysis produces data on social inclusiveness (Table 5).

Table 4. The tools and the respective indicators/outcomes of economic/financial analysis.

Tool	Indicators/Outcomes	Data Produced On
Value Added Analysis	(1) Total output value (2) Cost of intermediate inputs (3) Cost of fixed capital (4) Gross VA (5) Net VA (6) Income distribution by sources and agents (7) Competitiveness	Investment planning: Net value added
Financial Analysis	(1) Cost Benefit (CB) (2) Net Present Value (NPV) (3) Internal Rate of Return (IRR) (4) Payback Period (5) Total output value (6) Cost of intermediate inputs (7) Cost of fixed capital (8) Cash flows (9) Break-even point	Investment planning: Cost-Benefit, NPV, IRR, Payback period, Break-even point
PAM (Policy Analysis Matrix)	(1) Private Cost Ratio (PCR) (2) Private VA ratio (3) Domestic Resource Cost (DRC) (4) Social VA Ratio (5) Nominal Protection Coefficient (NPC) (6) Effective Protection Coefficient (EPC) (7) Domestic Factor Ratio (DFR)	-
End Market Analysis (Psychographic Analysis of Farmers/Consumers/Phase 2)	(1) Values (2) Attitudes (3) Behaviors (4) Preferences	Cultivation and consumption pattern: Willingness to pay, willingness to accept

Source: this table is modified by the authors based on reviewed guidelines (see Table 2).

Table 5. The tools and the respective indicators/outcomes of social analysis.

Tool	Indicators/Outcomes	Data Produced On
Employment Created	(1) Labor needs by agents-activities-process (2) Wage differentiation (3) Labor intensity: number of persons employed in various VC stages	Generated wage income
Gender Analysis	(1) Women and Young participation (2) Number of persons (M/F) employed in the value chain (sector) and trends	Social inclusiveness: Young/women participation
Decent Work Deficit Analysis	(1) List and level of health and safety risks. Incidence of occupational accidents in the work-place; working time lost due to sickness; worker perceptions of physical and mental well-being. (2) Job security and safety: type of employment (contractual status, legal benefits of the contracts, duration of contracts); presence of precarious conditions; presence of additional disadvantages due to gender, ethnicity, or race.	Social inclusiveness: Health and safety condition in labor market

Source: this table is modified by the authors based on reviewed guidelines (see Table 2).

4.4. Environmental Analysis

The evaluation of the environmental side of the VC is made by hot spot analysis, environmental assessment, and life cycle assessment. Environmental analysis produces data on the impact or non-impact of biodiversity, human health deterioration, resource depletion, ecosystem quality degradation (Table 6).

Table 6. The tools and the respective indicators/outcomes of environmental analysis.

Tool	Indicators/Outcomes	Data Produced On
Hot Spot Analysis	(1) Material consumption (2) Energy consumption (3) GHG Emissions (4) Water consumption (5) Land (erosion, pollution) (6) Air pollution (7) Water pollution (8) Waste (9) Biodiversity (10) Impact of environmental degradation on the VC	Impact on Biodiversity, human health, resource depletion, ecosystem quality
Environmental assessment	(1) Resource depletion (2) Ecosystem quality (3) Human health	Impact on Biodiversity, human health, resource depletion, ecosystem quality
Life cycle assessment	(1) Climate change-total, fossil, biogenic and land use (2) Ozone depletion (3) Acidification (4) Eutrophication- freshwater (5) Eutrophication- marine (6) Eutrophication- terrestrial (7) Photochemical ozone formation (8) Depletion of abiotic resources-minerals and metals (9) Depletion of abiotic resources-fossil fuels (10) Human toxicity- cancer, non-cancer (11) Eco-toxicity (freshwater) (12) Water use (13) Land use (14) Ionizing radiation, human health (15) Particulate matter emissions	Impact on Biodiversity, human health, resource depletion, ecosystem quality

Source: this table is modified by the authors based on reviewed guidelines (see Table 2).

5. Review of Case Study Results on Value Chain Analysis

A case study survey was done by the research team. They surveyed 204 case studies according to the structured questionnaire for investigating the VC tools and their related indicators. The case studies were mostly published between the years of 2015 and 2020.

The results show that among the reviewed case studies, cereals (33%), fruits and permanent crops (27%), and vegetables (21%) are the product groups which are mostly investigated by the different researchers/institutions. Legumes (7%), tubers (6%), and oily crops (5%) come behind them. Researchers generally have studied activity and agent-based approaches together in the same case (57%). The agent-based approach (31%) was used more than the activity-based approach (12%) (Figure 5).
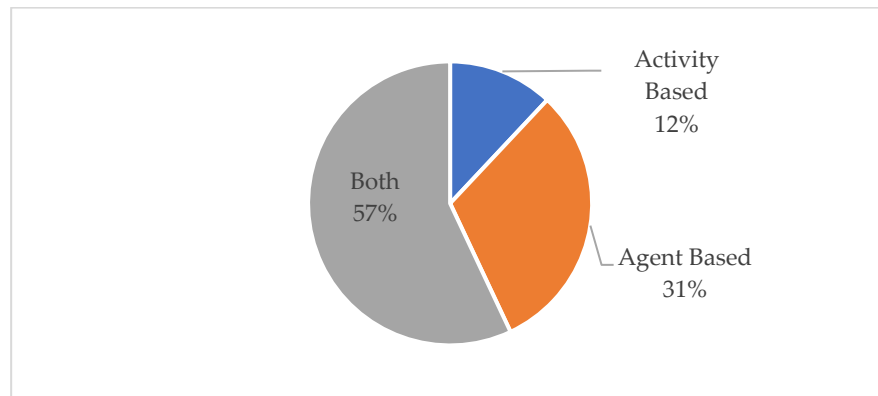
Figure 5. Agent or Activity-Based Approaches Used in the Case Studies Surveyed.

Most of the agents which generally exist in agri-food value chains have been included with their various importance, such as, farmers, processors, retailers, consumers, wholesalers, and input and service suppliers, respectively (Figure 6).
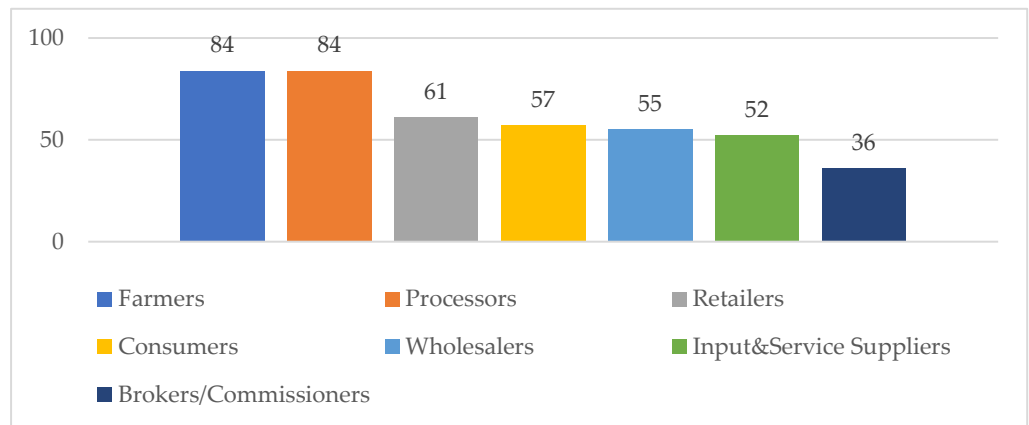

Figure 6. Group of Agents in the Case Studies Surveyed (%).

The main activities are also included in the agri-food value chain analysis as much as expected; production, marketing and distribution, processing, supply of inputs, and services and consumption, respectively (Figure 7).
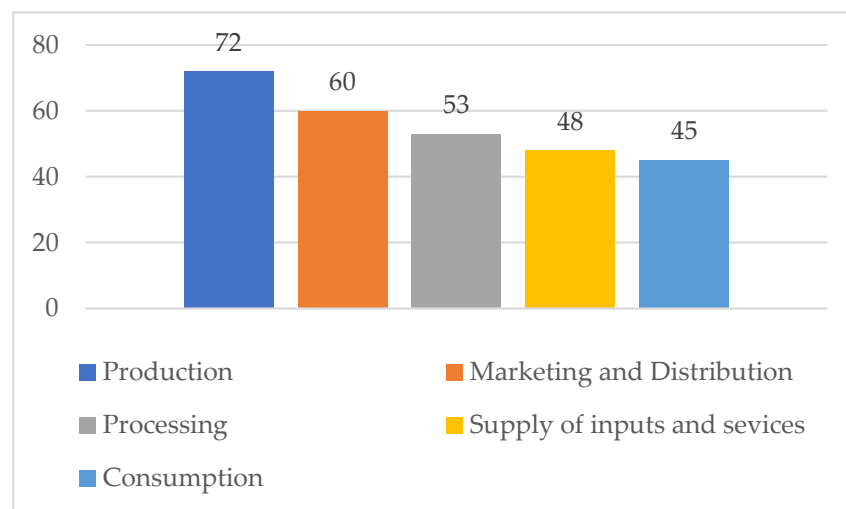
Figure 7. Group of Activities in the Case Studies Surveyed (%).

Figure 8 indicates the area of interest studied by the researchers, institutional/functional, economic/financial, social, and environmental analysis. The researchers have mainly studied institutional/functional analysis, which is the first step of value chain analysis. Another often-studied area of interest is the economic/financial analysis of value chains. The social and environmental sides of the value chain have been studied with less attention.
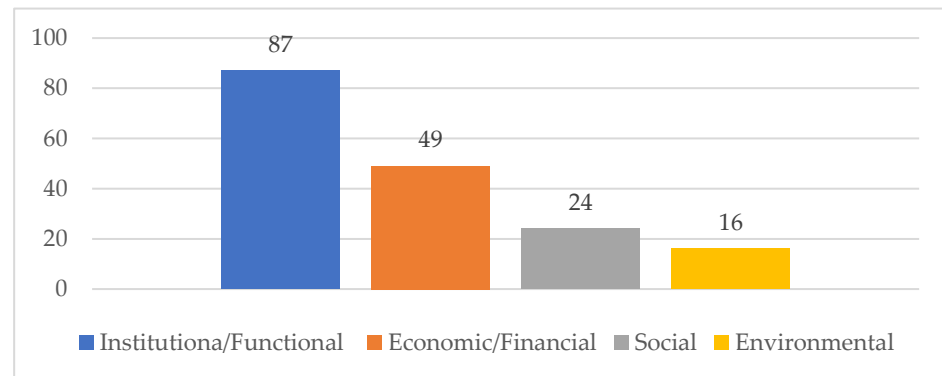
Figure 8. The Area of Interest in Case Studies Surveyed (%).

5.1. The Results on Institutional/Functional Analysis' Tools and Indicators

Figure 9 indicates the VC institutional/functional tools included in the case studies surveyed. It is very clear that researchers generally used mapping of the value chain, as it is an important area of interest for the VCA. The other tools are demand and supply analysis, governance analysis, end market analysis (phase 1-Export/Import condition), and SWOT analysis of VC, respectively.
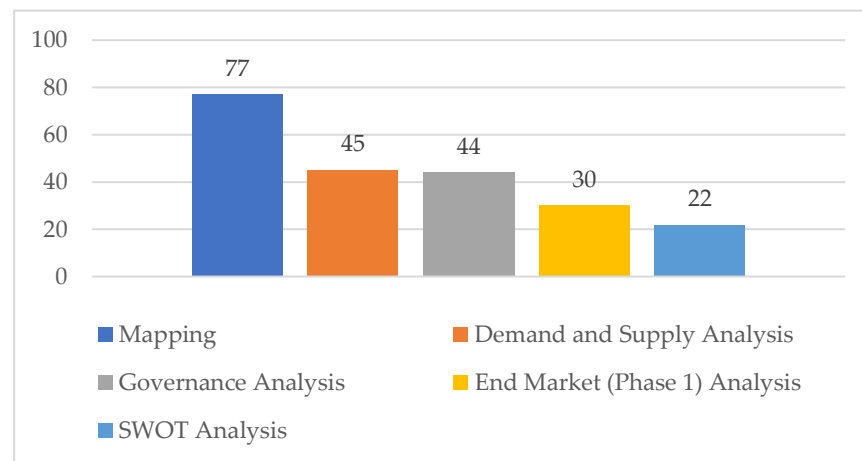
Figure 9. Institutional/Functional Analysis' Tools in Value Chains by Case Studies Surveyed (%).

According to the survey results, the most widely-used indicator is "mapping", and consisted of the mapping of agents (129 cases), the mapping of core process (activities) (127 cases), marketing channels (102 cases), and flows of products (97 cases). Additionally, for "governance analysis", the researchers have generally used the list of constraints (61 cases), quality standards (53 cases), and the rules and regulations and accession to market, technology and finance (42 cases), as a sort of indicator/outcome. The "demand and supply" conditions of the product have been investigated with the statistical data on area sown, yields, number of farmers, etc. (49 cases); export and import statistics (44 cases); and prices at national and international levels (41 cases). The "end market analysis" has been researched with the data of international (58 cases) and national (53 cases) market analysis. The last tool is SWOT analysis, known as a general tool which is widely used for the value chain analysis with the well-known indicators of SWOT (40 cases).

5.2. The Results on Economic/Financial Analysis' Tools and Indicators

Figure 10 shows the VC's economic/financial tools included in the case studies surveyed. Value Added analysis (37%) is a top research area on the economical side of the VCA. Consumer behavior (17%) and financial ratio analysis (15%) are also included in the case studies, although they are of relatively minor importance.
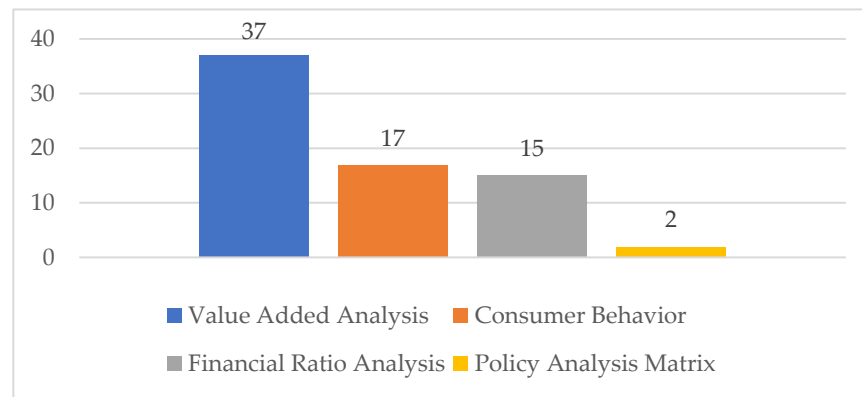

Figure 10. Economic/Financial Analysis' Tools in Value Chains by Case Studies Surveyed (%).

Value added analysis generally consists of the share of marketing and profit margin by agents (53 cases), the cost of intermediate inputs (48 cases), the total output value (38 cases), the net value added (27 cases), the gross value added (26 cases), and the cost of fixed capital (14 cases), respectively.

The research on consumer behavior of the VC has been focused on the consumers' preferences (29 cases), attitudes (28 cases), behaviors (26 cases) and values (21 cases), respectively.

Financial ratio analysis has been used in 15% of the surveyed case studies. Hence, the related indicators have not been studied as expected. Nineteen of the cases have cost benefit analysis; 18, 14, 6, 4 and only 3 cases have cost of intermediate inputs, total output value, net present value, internal rate of return, cash flows and cost of fixed assets, break-even point, respectively.

Policy analysis matrix (PAM) is included in only 4 case studies (2%) and its indicators are domestic resource cost, private cost ratio, private value added ratio, and social value added ratio. However, the utilization of them in the VCA is relatively very restricted.

5.3. The Results on Social Analysis' Tools and Indicators

Social analysis of value chains is an important issue which covers people with social inclusiveness on the basis of different genders and age groups of people, and also includes how much employment is created with decent working conditions (Figure 11). The tools given here are classified in the related guidelines with their relevant variables. The rest have been included with a large diversity of information which cannot be clustered in the guidelines reviewed.
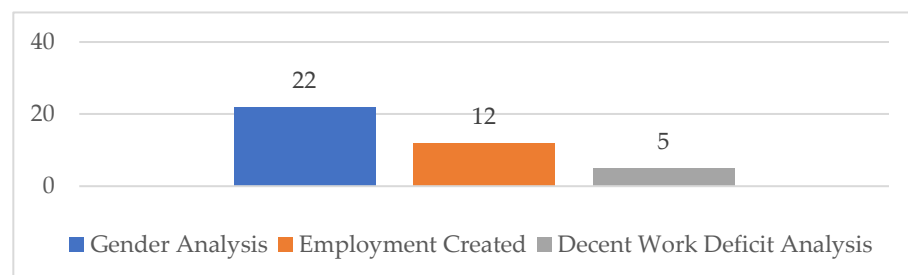

Figure 11. Social Analysis' Tools in Value Chains by Case Studies Surveyed (%).

Although the number of cases which include the social analysis have been given minor attention, this is the result of the aim of value chain analysis. Gender analysis is divided into two different areas of research concentrated on women and young participation in the VC. Created employment level is an important issue which is related to growth. A value chain should put effort into creating new employment opportunities as much as it can.

5.4. The Results on Environmental Analysis' Tools and Indicators

Environmental analysis tries to evaluate the environmental effects of the value chain, including the effects on human health, resource depletion, and ecosystem quality, which mainly result in biodiversity declining and many other environmental impacts. Environmental analysis of value chains has been done by using different approaches, such as hot spot analysis, environmental assessment, and life cycle assessment (LCA). Hot spot analysis is an analysis which has qualitative data, while the others are subjected to quantitative data analysis. It is seen that environmental analysis has been given limited attention by researchers, and hot spot analysis is preferred (8%) (Figure 12).
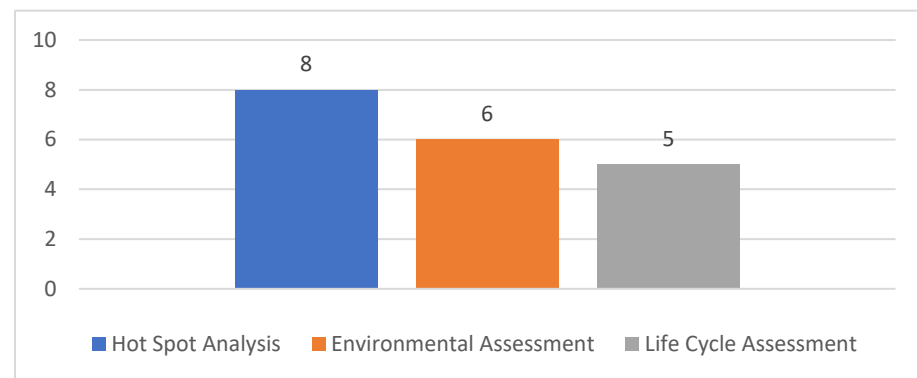

Figure 12. The cases detected and the tools used for the environmental analysis (%).

The main objective of hotspot analysis is to identify the key impacts of the related value chain. This analysis identifies the environmental and social impacts of each stage of the life cycle and their interrelationships. The stages where these impacts peak are referred to as hotspots [22].

The case studies are mainly concentrated on water consumption (12 cases), energy consumption (11 cases), GHG emission (11 cases), and land erosion and pollution (11 cases). The others come behind them, and the effect on biodiversity is studied in only 8 cases.

Environmental assessment and LCA are more comprehensive analysis approaches which need to use some specific software with the quantitative data. Each approach has different indicators. Environmental assessment analyzes human health (12 cases), resource depletion (11 cases), ecosystem quality (9 cases); and life cycle assessment analyzes different ecological data, such as land use (10 cases), climate change (9 cases) eco-toxicity (6 cases), acidifications (4 cases), depletions (2 cases), etc. The most cases provide some environmental assessments but do not include comprehensive methodological analyses, given here as tools.

6. Conclusions

We set out to verify the major hypothesis that the social and environmental impacts of the value chain are not sufficiently discussed in agri-food value chain analyses. Our broad-ranging review of the literature supported this hypothesis. Social and environmental impacts are indeed under-assessed. In this context, the study presents several additional major findings from the literature. First, in terms of method, we showed that value chain analysis can usefully be run using the four-dimensional approach. However, most VCAs are focused on institutional/functional and economic/financial analysis, with social and environmental effects under-studied.

The reviewed case studies mainly focused on the institutional/functional analysis of VCA. This focus is perhaps understandable given that the analysis provides a detailed profile of the industry. In the analysis, production, processing, marketing, and consumption processes are specifically identified, determined, and quantified. The main tool and first step of this analysis is "mapping" (77%). The other most often studied dimension is the economic/financial analysis of value chains. The economic/financial analysis aims at measuring and interpreting the profitability and financial sustainability of the value chain operations for all the actors directly involved.

This analysis can produce important information for investment planning, including farmers' and consumers' psychographic analysis covering their values, attitudes, behaviors, and preferences. This is mainly done to create value added through appropriate price transmission and investment. As a result of this study, value added analysis (37%) is shown to be a leading research area on the economics side of the value chain analysis. Moreover, the results show that cereals, vegetables, and fruits are the product groups mostly selected for VCA studies. Legumes, tubers, and oil-based crops come next after them. The case studies were generally based on an activity or agent-based approach. When the activity and agent-based approaches were compared, the agent-based approach was preferred.

As discussed above, the social and environmental side of the VCA are the neglected sides, with the least attention in the cases under consideration. Social analysis is concentrated in two dimensions. First, the social inclusiveness of the value chain analysis, and second, its social sustainability. In social analysis, gender analysis (22%) is the most often used tool.

However, the approach to evaluate the environmental sustainability of the value chain is of the utmost importance. This is because environmental analysis attempts to assess the impacts on human health, resource depletion, and ecosystem quality, which mainly result in the decline of biodiversity. The social and environmental sides of the value chain are the neglected sides of the analysis, with the least attention in the cases under consideration. *Thus, the research hypothesis of this study is accepted.*

Based on the review of existing methods and case studies, our strong recommendation is that the entire value chain should be analyzed using the four different dimensions, which are defined in the paper, for sustainable value chain management. The findings show that value chain analysis has been mainly concentrated on economic sustainability with many kinds of monetary and ratio-based data. The environmental impact of value chains has been under-studied, but can be analyzed by the measurement of biodiversity loss, greenhouse gas emissions, waste management and land, air, and water pollution, resource efficient energy uses, climate change impacts, and contribution to mitigation policies.

Another aspect of agri-food value chains was revealed by our analysis. This was that value chains have complex sets of interrelated elements, including public and private agents, domestic and foreign markets, inputs, outputs, production factors, institutions, the environment, and natural resources. These interrelations in the value chain need to be looked at from different points of view for policy making. Therefore, a number of potential policy recommendations can be examined to define the role and contribution of farmers:

- To train the farmers on sustainable farming practices such as organic, improved agricultural practices, and new technologies which diminish the over-exploitation of natural resources;
- To launch a support program on the cost of investment of new technologies, such as artificial irrigation and soil treatments;
- To establish a certification and labelling program for sustainable food products. The increasing complexity of the labelling landscape has raised concern about their efficiency and capacity to help food consumers make well-informed choices, particularly in favor of biodiversity.

Many of the policy recommendations have been directed to consumers, improving the theoretical understanding of the properties of value chain analysis and its role in economic, environmental, and social specifications:

- To address existing negative connotations, and educate people and increase awareness of the nutritional benefits of sustainable foods and products;
- To limit the increased food demand by adopting healthier diets and reducing food waste, as well as to limit the consumption of other material goods and services that affect biodiversity, such as forestry, energy, and freshwater supply;
- To create programs for advertising sustainable foods of interest, encourage their use in everyday cooking, promote their use as both food and medicine, and stimulate improvements in the culinary skills of consumers;
- To design effective nutrition promotion strategies to encourage healthy eating in adolescence, and targeting food supply and availability;
- To include principles of healthy diets and sustainable food consumption in public health programs, and to raise children's awareness of healthier and more environmentally-friendly food consumption;
- To bring policy makers, nutritionists, and agronomists together to develop a food system which balances productivity, sustainability, and the community's nutrition fulfillment to reinforce environmentally-friendly food consumption behavior.
- To provide information to consumers as part of environmental policy design, as findings from different countries highlighted that most consumers are still not ready to make food choices based on what is best for the environment.
- To increase taxes on less environmentally-friendly food products as a way to promote organic products.

Finally, it is highly recommended to establish a short supply chain. A short supply chain is a chain involving a limited number of economic operators, committed to cooperation, local economic development, and maintaining close geographical and social relations between farmers, processors and consumers. There are several different forms of short supply chain. These are direct sales from farmer to end-consumer, and community supported agriculture. Cooperative business enterprises or agents for each value chain activity should also be suggested. In this context, it is recommended that future studies should address the social and environmental dimensions of the value chain and promote biodiversity.

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