Deliverable 2.1

Reviewing of Agro-Food Value Chain Tools

	BIOVALUE Fork-to-farm agent-based simulation tool augmenting BIOdiversity in the agri-food VALUE chain
	SFS-01-2018-2019-2020: Biodiversity in action: across farmland and the value chain
	Report
	Public
	Lead: EGE, Contributing: AUTH, NIBIO, JLU, MAICH, CAPNUTRA, GFA
	Murat Yercan(EGE), Cihat Günden(EGE), H.Ece Salalı(EGE), Yarkın Akyüz(EGE), Pelin Atakan(EGE), Konstadinos Mattas(AUTH), Dimitra Lazaridou(AUTH), Sergaki Panagiota(AUTH), Marija Knez(CAPNUTRA), Lampros Lamprinakis(NIBIO), Signe Kaarstad(NIBIO), Hilde Halland(NIBIO), Irina Solovyeva(JLU), Nadja Kasperczyk(JLU), Gizem Yener(MAICH), Ahmed Alayidi(MAICH), Ilia Kunchulia(GFA), Lado Basilidze(GFA)
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Executive Summary

WP-2 assesses the current framework of agri-food value chain tools by analyzing the existing instruments for policy application, simulation, optimization, database and modelling tools for value chain management. WP-2 has four different tasks which are; Task 2.1. Review of agri-food value chain tools, and Task 2.2. Review of agent-based modelling tools and Task 2.3. Review of biodiversity in the value chain and the last task is Task 2.4. Selection of agent-based modelling tools suitable for agri-food value chain.

Task 2.1 is the literature review which are concentrated on the topics given as follows;

a) To review conceptual and analytical framework of value chains,
b) To generalize up-stream and down-stream of value chains,
c) To review value chain modelling tools for production process, investment planning, quality control, price transmission and product delivery channels,
d) To review of the causes and conditions that the consumption and cultivation of numerous crops (legumes, vegetables) were altered or completely eliminated,
e) To review the cultivation and consumption patterns of foods of interest with an assessment of consumers' needs; healthy and environmentally friendly foods.
f) To review the causes of biodiversity declined and factors that could be relevant for increasing biodiversity in the future.
g) To prepare the Milestone which is selected and tested modelling tool

According to these objected topics, the deliverable 2.1 which consists of twelve different parts which cover all mentioned areas of interests given above including policy recommendations, market related and practical recommendations and reference list. Each part is investigated and written by different partners of the BioValue Project. Task 2.1 initiated with the literature review on theoretical framework of value chain analysis. In section 2, the main and supportive activities clarify into the entire value chain and Porter's model has been discussed. And the main different pillars of value chain analysis are investigated such as Institutional/Functional analysis, Economic/Financial analysis, Social analysis and Environmental analysis. These different pillars have some value chain modelling tools (topic a). Agro-food value chain and interaction with biodiversity is included and the causes of biodiversity and the relevant factors for promoting biodiversity in future are reviewed in section 3 (topic f). It is underlined that climate change is the most important deriver for biodiversity loss. And some technical and sosio-economic solutions are presented for promoting biodiversity. These are solutions on "Land management", "water&waste management", "forest management and agroforestry", "pest management", "livestock management/balance with wildlife", green energy", "targeting women", "traditional crops, livestock", certification", "engaging young", etc.

Review process continues the causes and conditions that the cultivation and consumption of numerous crops (legumes, vegetables-BioValue crops) were altered or completely eliminated in section 4 (topic d). Consequently, in this section It is recognized benefits in reducing the risks in agricultural production systems and potential benefits to human nutrition and health should be the main drivers that will motivate farmers, researchers, breeders, nutritionists, agronomists, and policymakers to bring neglected species back to cultivation.

The context of deliverable includes an evaluation of consumption patterns of healthy and environmentally friendly foods in section 5 (topic e). It is explained that the increasing consumers'

demand for organics augment the rate of organic farming implementation and decrease the level of farmers' risk. From the farmers' point of view, it is important to receive information on consumer demand for organics to support farming decisions. Consumers' attitude is the most important predictor of intention to buy organic food.

The value chain modelling tools and the VC tools on up-streams and down-streams, modelling tools of the production processes, investment planning, quality control, price transmission and product delivery channels are investigated in section 6 and 7 (topic b and c). The study is initiated with the review of the Guidelines for the value chain analysis in section 6 and synthesized in section 7. It was found that 14 different guidelines are well known and generally used for the value chain analysis. Each one has some specific tools and indicators because of their specific objectives such as regional development, rural development, product development or product replacement, decent work analysis in a sector, etc. These are ILO; Value chain development for decent work, VCA4D; value chain analysis for development, FAO; Developing sustainable food value chain, FAO; value chain analysis for policy making, M4P; making value chain work better for poor, GFU; Promoting value chains of neglected and underutilized species, UNIDO; pro-poor value chain development and some others. Each guideline has concentrated on value chain analysis with the different modelling tools. FAO (2013) uses value chain modelling tools such as MAPPING, DEMAND and SUPPLY CONDITIONS, END MARKET ANALYSIS (Market research), VALUE ADDED ANALYSIS, FINANCIAL and PAM ANALYSIS. FAO (2014) uses ENVIRONMENTAL ASSESSMENT. M4P (2008) uses MAPPING, DEMAND and SUPPLY CONDITIONS, VALUE ADDED ANALYSIS, FINANCIAL ANALYSIS, EMPLOYMENT CREATION, GENDER ANALYSIS. GIS/GTZ (2015), FAO (2014) and VCA4D (2018) use HOT SPOT ANALYSIS, ENVIRONMENTAL ASSESSMENT and LIFE CYCLE ASSESSMENT as follows. These are given more detail into the section 6. These tools are collected into the four different dimensions which are Institutional/Functional analysis, Economic/Financial analysis, Social analysis and Environmental analysis. Some guidelines have full range of interest with the four dimensions, but some of them have less concentration of interest. Each dimension and tool has many outcomes.

In the section 8 (topic g), the research team perform a case study survey on agri-food value chains and their related tools used, in practice. This section is done in order to assist the realization of MS on testing and selection of agent-based modelling tools suitable for bioValue project. The aim of the case study review is to examine the case studies related value chain analysis in the agri-food sector and to determine which tools and outcomes are mostly used in these case studies. For this purpose, more than 200 cases have been surveyed according to Value Chain tools and their related indicators. As a result of survey, the value chain analysis has been done mostly in African and east Asian countries for cereals, fruits/permanent crops and vegetables. According to survey results, researchers have mainly surveyed the Institutional/Functional analysis which is the first step of Value Chain analysis. This stage focuses on the core process and agents for Mapping of the value chain which produce data on product delivery channels, up-mid-down-streams, quality standards and controls and governance of value chains, etc. The other most studied area of interest is Economic/Financial analysis of Value Chain. This is mainly done for the value-added creations, price transmission and investment planning to be foreseen, etc. The Social and Environmental side of the Value Chain have been neglected so far as parts of the Value Chain analysis. The Social side of the analysis can identify the degree of social inclusiveness in the community, women and youth participation into the economy or sector. Environmental analysis can produce data related to value chain that explain the environmental impacts on Biodiversity, Resource depletion, Human health and Ecosystem quality.

Section 9 (topic g) gives many outcomes, but they are inputs for the other WPs as well, such as

WP3, 4, 5 and 8. An overview of value chain modelling tools and their data produced are given table below. More detailed information can be found in the text.

An Overview of Value Chain Modelling Tools

	Functional/Institutional Analysis	Economic/Financial Analysis	Social Analysis	Environmental Analysis
Data will be provided on	1.Production process and Up- Down-streams 2.Product delivery channels 3.Cultivation and Consumption patterns 4.Quality control schemes 5.Investment planning 6.Price transmission	1.Investment planning 2.Cultivation and consumption patterns	1.Social Inclusiveness	1.Natural resource depletion 2.Ecosystem quality degradation 3.Human health deterioration 4.Global warming 5.Biodiversity loss
TESTED TOOLS	1.MAPPING 2.GOVERNANCE ANALYSIS 3.DEMAND&SUPPLY CONDITIONS 4.SWOT ANALYSIS 5.END MARKET ANALYSIS(Phase-1)	1.VALUE ADDED ANALYSIS 2.FINANCIAL ANALYSIS 3.POLICY ANALYSIS 4.END MARKET ANALYSIS (Phase-2)	1. EMPLOYMENT CREATED ANALYSIS 2. GENDER ANALYSIS 3. DECENT WORK ANALYSIS	1.HOT SPOT ANALYSIS 2.ENVIRONMENTAL ASSESSMENT 3.LIFE CYCLE ASSESSMENT (a software requirement)
TOOLS CAN BE SELECTED	1.MAPPING 2.GOVERNANCE ANALYSIS 3.DEMAND&SUPPLY CONDITIONS	1.VALUE ADDED ANALYSIS 2.FINANCIAL ANALYSIS 3.END MARKET ANALYSIS (Phase-2)	1. EMPLOYMENT CREATED ANALYSIS 2.GENDER ANALYSIS	1.HOT SPOT ANALYSIS (Qualitative approach of Life Cycle Assessment) 2.ENVIRONMENTAL ASSESSMENT

Source: Authors' elaboration from all literatures reviewed.

According to the information given in table, 5 different tools were depicted for the functional/institutional analysis of value chain but 3 of them can be selectable according to project objectives. These are MAPPING, GOVERNANCE ANALYSIS and DEMAND and SUPPLY Conditions. 4 different tools can be applicable for the economic/financial analysis but 3 of the are appropriated for the bioValue project. For social analysis of the value chain can be selected EMPLOYMENT CREATION and GENDER ANALYSIS as the tools of bioValue project. And the last one is the environmental analysis. For this side of analysis can be selected HOT SPOT ANALYSIS and ENVIRONMENTAL ASSESSMENT. It is underlined that environmental effects of value chain were neglected in the case studies surveyed. This is the main gap the analysts should studied on. Biovalue project will provide data not only on economic-financial-social sustainable value chain but also on environmental sustainable value chain which augments biodiversity.

Section 10 and 11 contains some recommendations for policy makers and marketing practitioners. The recommendations are listed for farmers, wholesalers-retailers-logistic and consumers. The most of the recommendations based on some policy interventions, regulations, project based developments which should be launched, by EU, Central government, local municipalities and international organizations. These are all for creating a sustainable agro-food value chains enhancing biodiversity.

It is recommended some special support for underutilized crops, local seeds should be implemented by input subsidies and deficiency payments. These provide reduced cost of

production and increased production income for farmers. On consumer base it is very important to address existing negative connotations and educate people and increase awareness of the nutritional benefits of underutilized foods and products. It would be recommended also to establish a short supply chain for entire value chain with an appropriate way such as community supported agriculture, cooperative enterprises and on-line platforms.

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1. Introduction

1.1 The Objectives of the WP2 and Task-1

The overall goal of this WP is to evaluate, analyze and investigate the literature and data sources regarding agri-food value chain tools. To do this, this WP foresees: - To review agri-food value chain tools used at the local, national and international level, as well as in various sectors, crops and vegetables - To review the literature on agent-based modelling tools, focusing on the agricultural sector - To review the pathways through which biodiversity has declined because of the modern value chain and highlight critical factors at play in increasing biodiversity - To select agent-based modelling tools suitable for modelling the agri-food value chain and incorporating biodiversity, climate and water availability.

Literature review is also ensured that the conceptual and analytical framework is up to date. All kind of information sources such as research reports, web-based information, product based and regional based research results have been analyzed to generalize up-stream and down-stream of value chains with a list of some agri-food value-chains. Such a review includes databases and tools modelling the production processes, investment planning, quality control, price transmission and product delivery channels. It will also include a review of the causes and conditions that the consumption and cultivation of numerous crops (legumes, vegetables) were altered or completely eliminated over the course of time. The review process is concentrated on the cultivation and consumption patterns of foods of interest and with an assessment of consumers' needs (healthy and environmentally friendly foods. In addition, based on relevant data provides some additional input on the pathways through which biodiversity has declined in the modern food value chain and possibly highlight some factors that could be relevant for increasing biodiversity in the future. This information will later on be linked to activities within WP4, WP5 and WP8.

1.2 Developing the Deliverable, Data and Methods Used

The methodological drafting began in November 2021, in consultation with task leaders of WP2 and the Leaders of WP3 and WP8 and the first attempt was initiated in monthly meeting of November 2021 with the preparation of the outline of D2.1. Another internal meeting with the partners of the WP2 has been organized in 7th of March 2022 on the discussion of other partners' contributions.

Feedback from the related other WPs and the partners into the WP2 was used to further progress on outline formation then ask to the partners for their contribution to establishing the text with their national or local information on agri-food value chain analysis done by the different researchers or institutes.

In order to identify and review the concept of "agri-food value chain tools", we proceed first with the theoretical information including some important-well known, widely used- the Guidelines of Value Chain Analysis (Table 1.1). 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 tools where each one has some specific objectives. It is called as a guideline-based review.

The second attempt is addressed to case study review on agro-food value chain analysis. This is done by searching the scientific databases: SCOPUS, WEB OF SCIENCE and EBSCO. The search was

filtered by publication date not later than 2000, fields in business, economics, agriculture and subject to “agro-food value chain”, ”agro-food value chain analysis” with the distributed crops group between the partners focusing on peer-review journal papers written in English and some national languages. Databases were distributed to Project partners with the different group of crops which BIOVALUE Project is concentrated on (Table 1.2). On these aspects, more than 200 cases surveyed by the partners. This would be a best way to realize the Milestone MS4 which is on “Selected and Tested Value Chain Tools Suitable for agri-food value chain”.

Some task partners have been invited to write some sections of the deliverable. Section 4: Causes and Conditions That the Cultivation and Consumption of Numerous Crops (Legumes, Vegetables) were Altered and/or Completely Eliminated and Section 5: Consumption Patterns of Healthy and Environmentally Friendly Foods: An Assessment of Consumer Needs were written by CAPNUTRA and AUTH teams as fallows.

Table 1.1 Value Chain Guidelines Reviewed

The Guidelines and Related Institutes*
1.ILO-Value Chain Development for Decent Work(2021)
2.VCA4D:Value Chain Analysis for Development(2018)
3.ACIAR- Australian Center for International Agricultural Research(2016)
4.GTZ/GIS-Guıdelines For Value Chaın Selection(2015)
5.FAO- Developing sustainable food value chains(2014)
6.FAO- VC Analysis for Policy Making(2013)
7.UNIDO- United Nations Industrial Development Organization(2011)
8.IIED - International Institute for Environment and Development(2008)
9.M4P:Making VCs Work Better for the Poor(2008)
10.USAID – United State Agency Internatinal Development(2008)
11.GFU-Promoting Value Chains of Neglected and Underutilized Species(2008)
12.CIAT - Centro Internacional de Agricultura Tropical(2007)
13.FAO - Rapid Appraisals(2007)
14.CIP-International Potato Center(2006)

*Sorted by years

Table 1.2 Main Databases Distributed to Partners and Biovalue Crops for Case Study Analysis

PARTNERS	SCOPUS-peer reviewed, grey literature	WEB of SCIENCE: peer reviewed, grey lit.	EBSCO-peer reviewed, grey lit.	National databases	Number of case studies reviewed
	Keywords			Keywords	
MAICH	"Value Chain Analysis, fruits, olive, grapes, cacao, coffee, banana,…"			All product groups given here	40
NIBIO	"Value chain analysis, cereal, wheat, barley, oat, rice, maize, rye,…."			All product groups given here	58
AUTH	"Value chain analysis, legumes, lentils, chickpeas, bean, peas, peanut, soya,…"			All product groups given here	15
JLU	"Value chain analysis, vegetable, tomato, cucumber, eggplant, pepper, lettuce, spinach, cabbage,…"			All product groups given here	35
CAPNUTRA	No accessibility to databases			All product groups given here	--
GFA	Accessibility only to national databases			All product groups given here	5
EGE	1) Value chain analysis, tuber, potato, sugar beet, cassava, yam, sweet potato… 2) Value chain analysis, oily crop, canola, sunflower, palm oil… 3) Environmental analysis of agri-food value chain			All product groups given here	51
	TOTAL CASE STUDIES SURVEYED				204

2. Theoretical Framework of Value Chain

Value chain was stated first by Michael Porter in his book, Competitive Advantage: Creating and Sustaining Superior Performance (Porter, M., 1985). He stated that a value chain is a set of activities created by companies to create value added for their customers. Value added is an adding value of each activity where the company has competitive advantage by reducing costs and resulting higher profitability.

The other conceptual study for Value chain is done by Kaplinsky and Morris. They explain the Value chain as a full range of activities that are required to bring together a product or service through the different phases of process to deliver to the final consumers and disposal after use. Furthermore, a value chain exists when all of the agents in the chain operate in a way that maximizes the generation of value along the chain (Kaplinsky, R. 1999; Kaplinsky, R. and M. Morris, 2001). These definitions can be commented in a narrow or broad approach which are given as follows.

In the narrow approach, a value chain focuses on a single firm and includes the conception and design stage; the acquisition of inputs; production, marketing and distribution activities; and the performance of after-sale services.

The broad approach of defining a value chain looks at the complex range of activities implemented by various agents (primary producers, processors, traders, service providers) to bring a raw material through a chain to the sale of the final product. The 'broad' value chain starts from the production system of the raw materials and will move along the linkages with other enterprises engaged in trading, assembling, processing, etc.

The broad approach does not only look at the activities implemented by a single enterprise. It also includes all its backward and forward linkages, until the level in which the raw material under process will be linked to the final consumers.

The broad concept of value chain also contains the issues of organization and coordination, the strategies and the power relationships of the different actors in the chain. For now, it is important to understand that conducting a value chain analysis requires a thorough investigation of what is going on between the agents in a chain, what keeps these agents together, what information is shared, and how the relationships between agents is evolving.

In addition, the idea of broad concept of value chain is associated with the concept of governance, which is of key importance for those researchers interested in the social or environmental facets of value chain analysis. The establishment (or the evolution) of value chains may put pressure on natural resources (such as water or land) which may result in degradation of the soil, loss of biodiversity or pollution.

Value activities can be divided into two broad types: Primary activities and support activities. Primary activities, listed along the bottom of Figure 2.1, are the activities involved in the physical creation of the product and its sale and transfer to the buyer. Support activities assist the primary activities and each other by providing purchased inputs, technology, human resources and various firmwide functions (Porter, M., 1985).

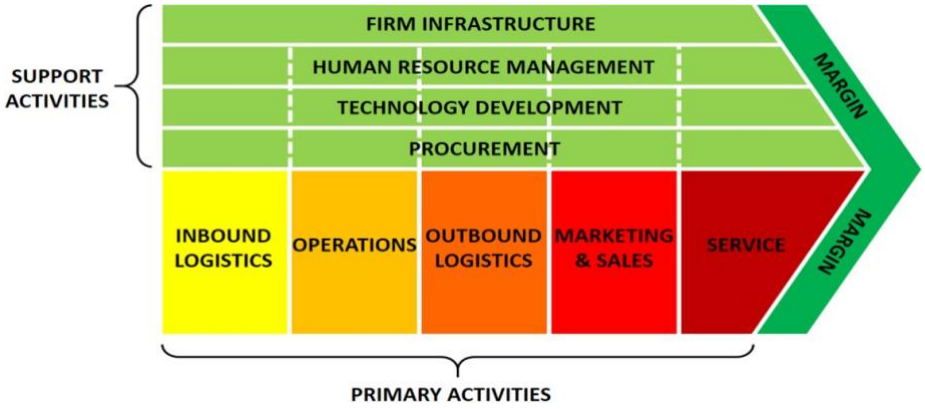

Figure 2.1 Porter's Generic Value Chain (Porter, M., 1985)

There are five generic categories of primary activities involved. Each one of them is divisible into a number ofdistinct activities that depend on the particular industry/firm strategy (Porter, M., 1985). These are:

- **Inbound Logistics**: Activities on receiving, storing and disseminating inputs to the product.
- **Operations**: Activities on transforming inputs into the final product form such as packaging, assembly, equipment maintenance.
- **Outbound Logistics**.: Activities on collecting, storing and physically distributing the product to buyers.
- **Marketing and Sales**: Activities on the buyers can purchase the product and inducing them to do so.
- ***Service**: Activities on providing services to maintain the value of product.

There are four generic categories of support activities involved. Each one of them is divisible into a number of distinct activities that depend on the particular industry/firm strategy (Porter, M.,1985). These are:

- **Procurement**: This is to the function of purchasing inputs such as raw material, consumable items and assets of inventory.
- **Technology Development**: The use of a technology and technology development
- **Human Resource Management**: These are recruiting, hiring, training, development and compensation of all types of personnel.
- **Firm infrastructures:** This is the number of activities on planning, financing, accounting, legal, government affairs and quality management.

The Value Chains (VCs) considered in this brief are the sequences of productive actors that contribute directly to supply a specific good to the domestic and/or export market. VCs are major channels for agricultural development due to their capacity to mobilise resources from various economic sectors, create economic value and generate employment. They offer an operational framework for engaging with farmers, businesses and policy makers to improve income generation in an inclusive and sustainable way (European Commission, 2018).

Past development operations frequently focused on increasing agricultural produce, whilst often ignoring themarket and other economic drivers involved. Production activities are part of a wider network of interdependent businesses, and it is therefore essential to examine them within the VC

as a whole. Moreover, interventions in agriculture seldom paid enough attention to the related environmental and social impacts. Yet, decision makers must ponder the fact that VC activities take place in, and influence, a social and environmental context.

The reviewed guidelines show that Value chain analysis can be run into the four-dimensional approach. Of course, these are mostly depending on the guidelines' objectives, but these are varying generally on Institutional/Functional and Economic/financial analysis of Value chains. A minority of them can observe the activities on the base of social and environmental awareness. Hence, this text will consist of an approach with the four dimensions of the Value Chain analysis: a) Institutional/Functional, b) Economic/Financial, c) Social and d) Environmental evaluation.

A. Institutional/Functional analysis of the Value Chain

The Institutional/functional analysis aims to build an overall description of the value chain system. It identifies and characterises the main actors and stakeholders involved and expands on some of the main strategic development challenges faced. Essential elements include determining a typology of actors/agents, the various sub-chains and the geographic and time frames, which form the basis of all the analyses in order to reply to the framing questions. Key components for the value chain system are: the sequence of products, the actors/agents involved, the functions they fulfill, the flows linking the actors and the overall governance of the VC (Figure 2.2) and some deliverables presented in Table 2.1.

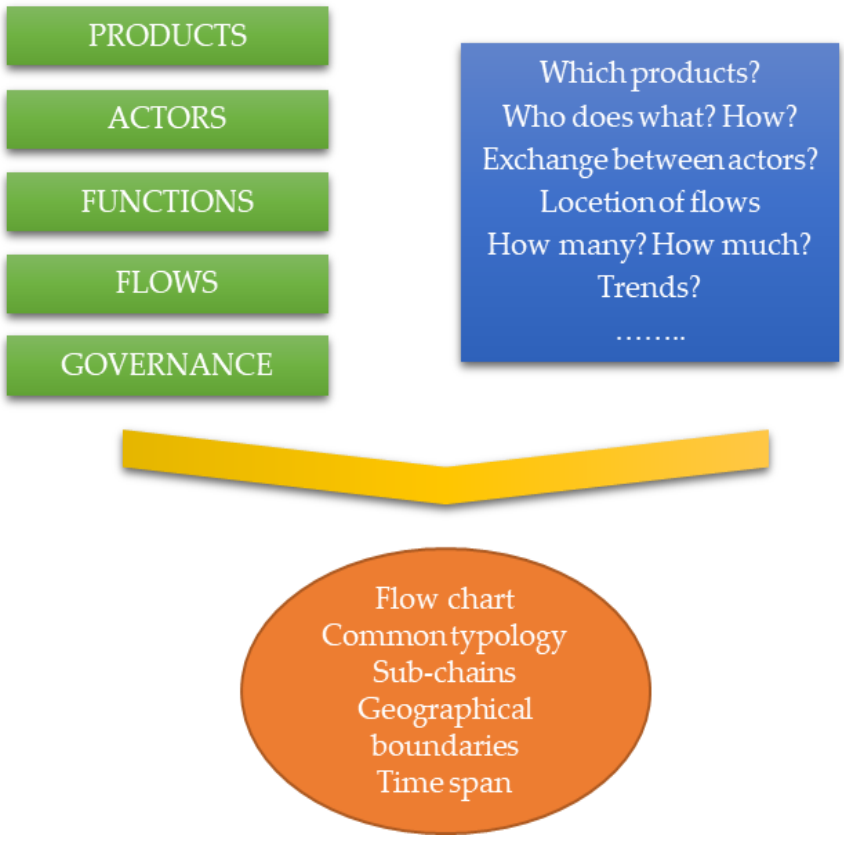

Figure 2.2 Functional Analysis of Value Chain(European Commission, 2018).

Table 2.1 Functional Analysis Deliverables

Type of Deliverables
1) A general description of the products, stages and technical processes;
2) The types of actors, their main features and practices;
3) The input dealers and support services;
4) The flows, their volumes, with a clear view of end-markets considered and geographic distribution;
5) The organisation and governance;
6) A description of the business environment, policies, institutional and societal context;
7) The major market trends;
8) An overview of the strategic importance and trends of the VC for the actors and for the country as a whole;
9) A SWOT matrix highlighting the main advantages, challenges and shortcomings deriving from all these elements

Source: European Commission, 2018.

Institutional/functional analysis is consist of several modelling tools. These are MAPPING of value chain, GOVERNANCE analysis, DEMAND and SUPPLY conditions, SWOT analysis and END-MARKET analysis.

MAPPING OF VALUE CHAIN

A value chain map is an illustrative way of describing the structure and agents involved in bringing the product or service from its basic raw materials through final consumption. The value chain map can be a useful tool to guide the research, and so setting out the map (at least an initial understanding of it) is an important activity to be carried out before the field research begins. The mapping will help determine the approach to the field research, including the sampling strategy for surveying. Value chain maps provide an easily digestible way to understand the processes and pathways the production and sales by illustrating, in a simple form, the complexities of an industry, sector, subsector, product of value chain. To understand the value chain that is to be analysed, models, tables, figures and diagrams are used. MAPPING includes of so many different information about the related value chains (M4P, 2008). These are;

1) Functional Analysis of agents 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 level

GOVERNANCE ANALYSIS

The analysis of governance aims to investigate the rules operating in a value chain, and the system of coordinations, regulations and control in which value chain is generted along a chain. Governance refers to both the “official” rules that address output and the commercial imperatives of competition that influence how production is structured. Governance analysis is based on the 1)Understand how the value chain is coordinated, including key agents and mechanism (i.e. contracts, agreements, services) and 2) Formal and Informal rules, regulations and standarts that influence the value chain (M4P, 2008). GOVERNANCE analysis includes data on; 1) Types of rules and standarts&Regulations 2) Matrix of Regulations and Agents 3) Quality standarts 4) Rewards and Sunctions 5) Access to market, Technologies, finance, skills&knowledge 6) Vertical-Horizontal integration 7) List of constraints (and type of constraints) 8) List

(and type) of relevant economic support programmers running and planned for 9) Cultural norms, values, believs, attitues, lifestyle and behaviours that influence consumer preferences, business practices and producer organisation.

DEMAND and SUPPLY CONDITIONS

This is the analysis of Value chain which the investigation starts with the general overview of the sector and the background information of the related value chain (FAO, 2013) (M4P, 2008).

Demand analysis looks at the consumer side of a value chain considering the various destinations of the final output(s). Under this component, the following elements are normally considered: 1) Current and potential (future) domestic and foreign demand for the value chain outputs (including trends and/or forecasts). 2) Domestic and/or international output prices and price trends. 3) Socio-economic features of current and potential customers, including spending capacities. 4) Current and potential foreign competitors. 5) Specific features of products, including product diversification to target different types of clients. 6) Current or potential substitutes that influence prices or volume demanded 7) Other issues related to demand, such as dependency from economic cycles or other determinants of demand.

Supply analysis looks at the producer side of the value chain and their features. Under this circumtances, the data is analysed as follows; 1) Production trends 2) Export&Import quantity of trends and the market destinations 3) Prices at the local, national and international level and their seasonality trends 4) Major competitor countries 5) Supply Utilization which means the sharing of the product between the flows 6) The reason of the obstacles infront of the foreign trade expansion.

SWOT ANALYSIS

SWOT is a business tool to analyze internal and external factors that can affect Value Chain. SWOT Analysis, also known as SWOT Matrix, helps to evaluate strengths, weaknesses, opportunities and threats that Value Chain face by focusing on strengths, minimizing threats, and taking the greatest possible advantage of opportunities available in the future.

END-MARKET ANALYSIS-Phase I

End-market analysis is consist of two different types of research area; Primary and Secondary. Primary end-market analysis is the research area of institutional/functional part of value chain analysis. The Primary End-market analysis should be used as a foundation for the Competitiveness Strategy to upgrade the Value Chain to build products and services for which clearly defined customer segments will pay premium prices. Moreover, Primary End-market Research tools (surveys, in-depth interviews, focus groups & observation) should be used to define the needs of particular customer segments that the Value Chain would like to target (USAID, 2008).

Institutional/Functional analysis of VC produces the modelling data on **Up-Streams and Down-Streams of VCs, Quality controls, Price transmission, product delivery channels and some others.**

B. Economic/Financial analysis of Value Chain

The economic/financial analysis aims at measuring and interpreting the profitability and sustainability of the value chain operations for all the actors directly involved. Its purpose is to inform on the economic effects of the value chain within the national economy in terms of growth generation and distribution of incomes. It also assesses its competitiveness and viability within the global economy (Figure 2.3). So, Economic/Financial analysis uses the data on monetary and the data equivalent monetary in general.

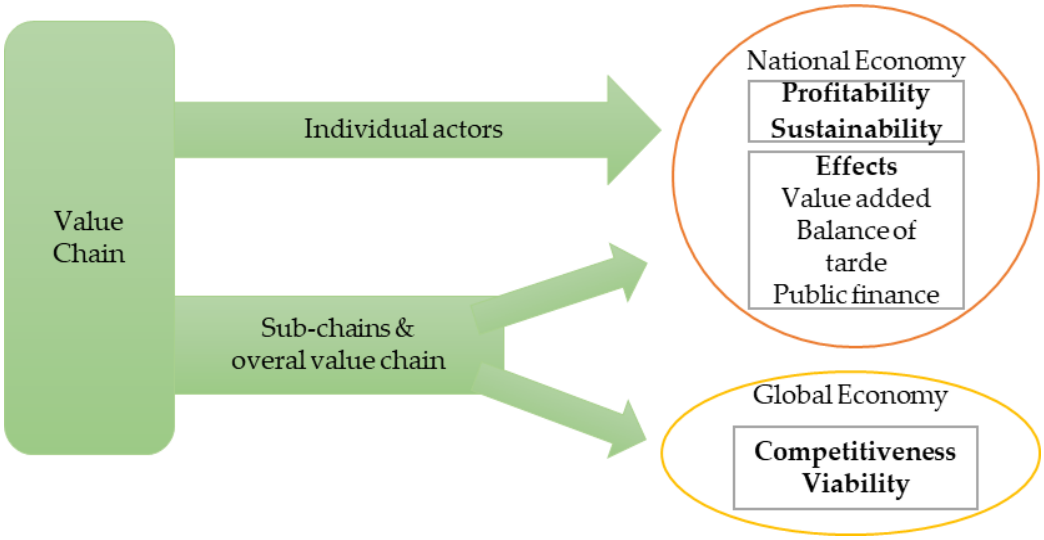

Figure 2.3 Economic Analysis of Value Chain (European Commission, 2018)

Economic/Financial analysis includes VALUE-ADDED analysis, FINANCIAL analysis, POLICY ANALYSIS MATRIX(PAM) and END-MARKET analysis phase II.

VALUE-ADDED ANALYSIS

This is an analysis of Value chain Which assesses in quantitative terms the creation of "Value Added" and its distribution to the various agents involved. The Value Added is a measure of wealth created in an economic system by a production process, net of the resources consumed by the process itself. More specifically: a) The value added created by the overall value chain. b) The value added and margins for each economic agent at each stage of the chain. c) The allocation of value added among production factors (capital labour, other assets) and the public budget, through the respective distributive variables: (profits, wages, rents and taxes) (FAO, 2014).

FINANCIAL ANALYSIS

This is the financial ratio analysis. Before deciding to enter a new market or business a person must fi rst determine which business is the most profi table for them. Revenues, costs and margins of value chains should therefore be compared (both different marketing channels and different product chains), but also the potential for scaling up and the required investments should be investigated. After the value chain has been mapped the next step is to study certain aspects of a value chain in depth. There is a wide choice of aspects that can be further elaborated upon. One of these is costs and margins. The cost is the money that an agent in the value chain contributes, while the margin is the money that an agent in the value chain receives, minus the costs. Financial analysis is generally based on the evaluation of Payback Period, Net Present Value(NPV) and Internal Rate of Return(IRR), Cost-Benefit Analysis (CBA) (M4P,2008).

POLICY ANALYSIS MATRIX-PAM

The concept of Policy Analysis Matrix (PAM) is used to demonstrate the extent of governmental interventions in economy and to unravel the sources of comparative advantages and divergences within it. PAM measures a degree to which observable market prices for a particular farm product differ from efficiency (social) prices. This analysis clearly shows the impact of governmental

interventions in agricultural production, where private and social profitabilities are evaluated on the basis of existing private and social revenues and costs that occur inside the given farm system. The importance of applying PAM tools for the purpose of investigating numerous policy effects is especially apparent in agricultural systems undergoing transition. Various PAM coefficients derived in this study reveal a contrasting attitude of a government in treating the market of two (hypothetically taken) farm products. This has resulted in the existence of a comparative advantage for one agricultural good and in the social non-profitability for another farm commodity (FAO, 2013).

END-MARKET ANALYSIS-Phase II

This is the marketin research which is mainly concentrated on consumer research. Value-chains are defined as a sequence of processes in linked businesses that transform raw materials into products, services and information that consumer's value and will pay for. It is the consumer who determines the characteristics of 'value', so that is why we refer to 'value in the eyes of the consumer'. Thus, 'value-chains' are focused on the delivery of value to consumers. Whether the aim is to analyze the efficiency and effectiveness of an existing value-chain or develop a new chain, it is important first to understand the attributes of consumer value. Psychographic analysis will be added to identify the underlying factors influencing the consumption decision-making process (ACIAR, 2016).

Economic/Financial analysis produces the modelling data on **Price transmission, Investment Planning, Production process and consumption patterns and some others.**

C. Social analysis of Value Chain

Social analysis is concentrated on two dimensions. First is the social inclusiveness of the value chain. In this part of the analysis, it is demonstrated how the VC **organisation** and **governance** involve the various stakeholders and how **income** and **employment** generated are distributed among social groups. The value chain specific impact on vulnerable groups such as subsistence-oriented farmers, smallholders, **women**, **youth**, and **marginalised people** (landless rural workers, minority communities…) is closely documented (Figure 2.4).

Figure 2.4 Social Inclusiveness of The Value Chain (European Commission, 2018)

Social analysis is consist of three different tools. These are mainly on EMPLOYMENT CREATION, GENDER ANALYSIS and DECENT WORK DEFİCİT ANALYSIS.

EMPLOYMENT CREATED

Analysing the distribution of employment within thevalue chain is central to understanding how to increase the participation of the poor. Understanding how employment is distributed along the

chain provides the necessary start to determine opportunities for employment generation. Distribution of employment is not only an analysis within a particular value chain but also recognises that individual agents participate in a number of different value chains at the same time. The objectives of this analysis is to analyse the impact of the value chain on the distribution of employment within and between various levels of the value chain at the level of the individual actors, to describe distribution of employment along the value chain and amongst the different wealth classes and determine how the poor and other disadvantaged groups participate in the chain, to describe the dynamics of employment within and along the value chain and the inclusion and exclusion of the poor and other disadvantaged groups, to analyse the impact of different value chain governance systems on employment distribution, to analyse the impact of different value chain upgrading strategies on employment distribution (M4P, 2008).

GENDER ANALYSIS

The objectives of gender analysis in the development context are to determine the characteristics and dynamics of gender systems, the forms of disadvantage, which they create for women in different settings and the developmental costs, and consequences of gender stratification. Only on the basis of such understanding can the ultimate goal for all gender work – the design of gender policies that will be effective in improving gender equality, usually by reducing women's specific disadvantages – be met. The value chain approach may help in refining the understanding of the nature and causes of variations in the forms of women's disadvantages in the sphere of economic production, in ways which suggests new possibilities for gender policy (ILO, 2021).

DECENT WORK DEFICIT ANALYSIS

Decent work deficit analysis, part of ILO's Value Chain Development for Decent Work guidelines, aims to understand what is causing sectors to under-perform –and why decent work deficits are persisting. It is important to start with an open approach to the analysis phase, scanning all potential decent work deficits and understanding which are most important to the target group. The decent work focus can then be narrowed down over time based on empirical evidence – rather than starting with a 'predetermined' focus which might not reflect the most important decent work deficits. The analysis can be built on the following common research topics: (1) Skills and employability, (2) Earning and income, (3) Job security and safety, (4) Health and well-being, and (5) Rights, respect, and cooperation (ILO, 2021).

D. Environmental Analysis of Value Chain

Environmental analysis of value chain mainly relates with the "Resource depletion", "Ecosystem quality", "Human health", "Climate change and "Biodiversity" terms. By combining data and findings on the various areas related with the topics above, qualitative and quantitative appraisal has to be done for the environmental sustainability of the value chain (European Commission, 2018).

The approach to evaluate the environmental sustainability of the value chain is twofold, based on thequantitative **Life Cycle Assessment (LCA)** accompanied by an **exploratory assessment of biodiversity risks** (Figure 2.5).

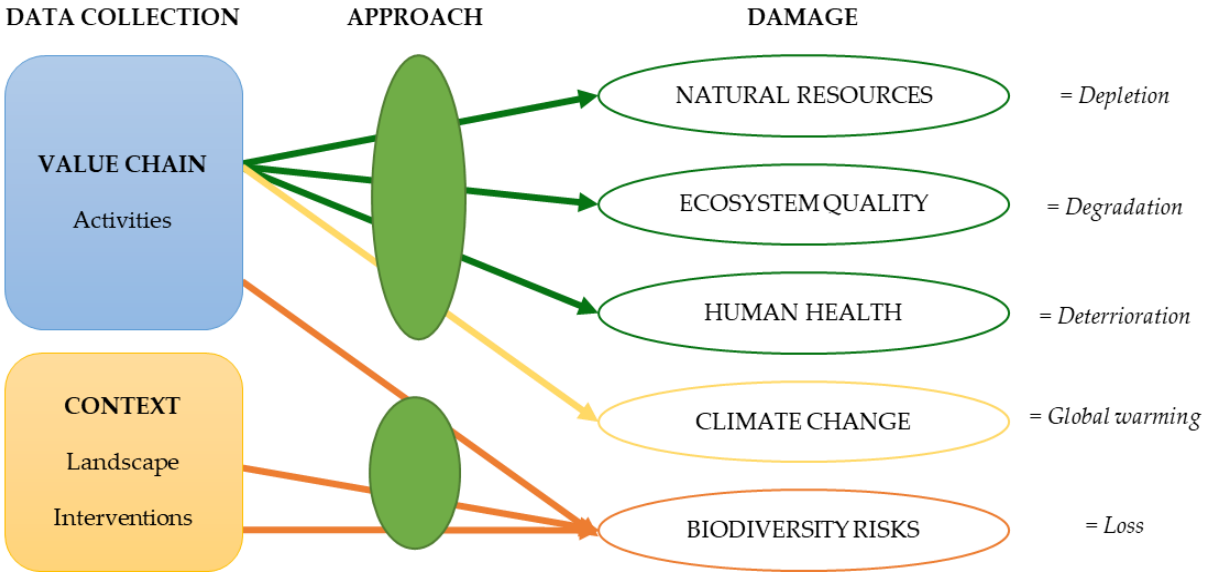

Figure 2.5 Environmental Assessment of Value Chain (European Commission, 2018).

Environmental analysis includes several tools such as LIFE CYCLE ASSESSMENT, HOT SPOT ANALYSIS and ENVIRONMENTAL ASSESSMENT.

LIFE CYCLE ASSESSMENT (LCA)

The life cycle assessment (LCIA) aims to understand and evaluate environmental impacts based on the inventory analysis, within the framework of the goal and scope of the study. In this phase, the inventory results are assigned to different impact categories, based on the expected types of impacts on the environment. Impact assessment in LCA generally consists of the following elements: classification, characterization, normalization and valuation. Classification is the process of assignment and initial aggregation of LCI data into common impact groups. Characterization is the assessment of the magnitude of potential impacts of each inventory flow into its corresponding environmental impact (e.g., modeling the potential impact of carbon dioxide and methane on global warming). Characterization provides a way to directly compare the LCI results within each category. Characterization factors are commonly referred to as equivalency factors. Normalization expresses potential impacts in ways that can be compared (e.g., comparing the global warming impact of carbon dioxide and methane for the two options). Valuation is the assessment of the relative importance of environmental burdens identified in the classification, characterization, and normalization stages by assigning them weighting which allows them to be compared or aggregated. Impact categories include global effects (global warming, ozone depletion, etc.); regional effects (acidification, eutrophication, photo-oxidant formation, etc.); and local effects (nuisance, working conditions, effects of hazardous waste, effects of solid waste, etc.) (Roy et al.,2009)

HOT SPOT ANALYSIS(HSA)

The Hot Spot Analysis (HSA) is a qualitative tool that is relatively low cost and not very demanding. Like the Life Cycle Analysis (LCA), the HSA aims at identifying ways to improve resource efficiency and reduce negative environmental impacts.

In many cases, it is easier to restrict an analysis to a qualitative assessment. The method recommended here is a qualitative approach, based on stakeholder involvement, to identify

environmental 'hot spots' along the value chain. Hot spots indicate critical problems related to inefficient resource use, high GHG emissions and further environmental problems at the various stages (or 'life cycle phases') of the value chain (GTZ/GIS, 2015).

ENVIRONMENTAL ASSESSMENT

Environmental Assessment (EA) is a structured approach to predicting the impacts of a proposed action before it is implemented. An EA is generally used when the impacts of an action cannot be understood without a systematic and focused study. Once the impacts are known or estimated, measures can then be taken to avoid damaging the environment (including the livelihoods of people living in that environment) and enhance benefits. Environmental assessment is a tool to prevent unnecessary damage that can be expensive to repair once the action has been implemented. The environmental sustainability analysis assesses the value chain's impacts on the natural environment by categorizing these impacts according to severity. The analysis identifies critical areas (hotspots) that may require more in-depth measurement and analysis at a later stage (VCA4D, 2018).

Environmental Analysis of Value Chain produces modelling data on **the factors that could be relevant for increasing biodiversity, human health, eco-system quality, natural resource depletion**.

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3. Declining and Promoting Biodiversity

Food value chain are formed by all activities in food production, transformation, distribution, and consumption, including those leading to food losses and waste. The interaction and interdependence of food system, human health, and biodiversity are complex. Sustainable food systems are needed for human health, but the sustainability of food value chain depends fundamentally on the preservation of their biodiversity. Sustainable food value chain promotes global outcomes of people, sustainable environment, social equity and economic resilience. The task of transforming food systems to deliver sustainability requires integrated actions in order to conserve biodiversity and reduce the impacts on the environment, to shift towards sustainable practices in production, processing and consumption, to improve socio-economic welfare and to consider cultural adequacy of food practices. In these perspectives, the biodiversity of plants, animals and micro-organisms used directly for food and agriculture which has a crucial role in promoting sustainable food systems (Jacob, M.C.M., et al. 2021).

The Sustainable Development Goals (SDGs), including zero hunger, clean water, sustaining life on land and in water, and climate action, are seen to be influenced by the global food production system and the conservation of biodiversity in and around agricultural land (Ortiz, 2021). On other side, covering about 40% of the global land surface, agroecosystems (including rangelands) constitute the largest terrestrial ecosystem in the world, even though they are highly modified and heterogeneous. As with natural ecosystems, biodiversity in agroecosystems is under great threat, with serious implications for the resilience and sustainability of both food production and environmental goods and services (CGIAR, 2021). In response to this, challenges such as population growth, food insecurity and resource scarcity, together with climate change, are putting enormous pressure on production systems. In these circumstances, the agricultural sector faces the dual challenge of producing enough food for an ever-growing population, and not compromising the environment and natural resources. These challenges must be met using limited land and water resources (Mamabolo et al., 2020).

The concept of sustainability has been studied at various levels of reference and context, from the environment to socioeconomics. From an agricultural perspective, to fully understand the principles underlying sustainability, it is necessary to recognize the importance of biodiversity. Biodiversity is recognized as a key determinant of ecological function, sustainability and stability (Mamabolo et al., 2020). Furthermore, biodiversity among agricultural crops or livestock is known as agricultural biodiversity. This diversity results from thousands of years of natural and human selection for favored traits, affecting characteristics such as yield, size, taste and adaptation to different production conditions (Gwinner and Neureuther, 2018).

The impact of agricultural production on biodiversity has been extensively studied, from local-scale impacts of intensification strategies such as fertilizer use, pesticide application, tillage or alternative farming methods, to large-scale analyses of the effects of land conversion or intensification on biodiversity. More recently, research studies have examined the other side of the agriculture-biodiversity relationship, namely the impacts of biodiversity on agriculture. These studies have shown that biodiversity benefits to agricultural production, such as pollination and pest control, can increase both yields and system resilience (Ortiz et al., 2021).

Therefore, agricultural development can play an important positive role in conserving agricultural and ecological biodiversity and ensuring that food production is both promoted and sustainable. Sustainable agricultural practices such as soil, water, forests and fisheries stocks can conserve and

enhance biodiversity. Linking practices and products to value chains and increasing consumer demand for sustainably developed products can also increase smallholder farmers' incomes and livelihoods. Therefore, shifting attitudes, behaviors, policies and practices towards greener food production and consumption systems is essential to increase the sustainable use and conservation of biodiversity and to farm for biodiversity (Gwinner and Neureuther, 2018).

In Agriculture, on the other hand, recognizing the link between sustainability and biodiversity, policy makers are still looking for credible approaches that can promote sustainable food production while reducing biodiversity loss. In this context, government programs that encourage farmers to adopt biodiversity-friendly agricultural practices provide a critical opportunity to promote biodiversity conservation and agricultural practices that are in line with global sustainability goals (Maas et al., 2021). Nevertheless, the question remains whether sustainability can be achieved while preserving biodiversity in agriculture. The researchers think this is possible based on advances in agro-ecology research on the possibility of agricultural systems achieving sustainable food production without degrading natural resources (Mamabolo et al., 2020). In particular, they argue that a shift to sustainable intensification can provide economic, environmental and social benefits to rural communities and under-resourced farmers, while protecting ecological resources such as biodiversity, and thus ensuring sustainability and food security. It is claimed that the future of biodiversity-conserving agriculture will largely depend on (1) the adoption of biodiversity-based agriculture, (2) stakeholder collaboration, (3) improved environmental literacy, and (4) advances in policy planning and implementation.

In this chapter, First, the main causes of declining biodiversity are underlined and Second, the needs to promotion of biodiversity are discussed.

3.1 The Causes of the Biodiversity Decline

The conservation and sustainable use of biodiversity are not just environmental issues but also prerequisites for economic production processes, services and quality of life. The loss of biodiversity threatens economic units, especially those in the food industry that rely on nature for their supply of raw materials (Trotschler, et.al., 2016).

Small-scale agricultural systems, which rely on a large number of species, cultivars and breeds, selected for their ability to adapt to different environments are today marginalized. Biodiversity is the result of the interaction between the environment, genetic resources and management systems and practices used by culturally diverse people ways. And this is the variety and variability of animals, plants and micro- organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fiber, fuel and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil micro-organisms, predators, pollinators), and those in the wider environment that support agro-ecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of the agro-ecosystems (FAO, 1999).

Biodiversity loss refers to the decline or disappearance of biological diversity. This continues at an alarming rate in all conditions. It is defined as “the long-term or permanent qualitative or quantitative reduction in components of biodiversity and their potential to provide goods and services, to be measured at the global, regional, and national level”. Approximately one million animal and plant species on the planet are on the verge of extinction, with many of them expected

to go extinct within decades Currently, about 37,400 species have been listed as being in danger of extinction (Tan, Y.L. et al 2022).

Global conservation assessments are underlined that available for 30% of known edible plant species, and 11% of these are classified as threatened, putting them at risk of extinction. Although the use of traditional crop varieties persists, of more than 6,000 different plant species cultivated for food, just 9 (sugarcane, maize, rice, wheat, potatoes, soybeans, oil-palm fruit, sugar beet and cassava) contribute around 66% of total crop production. Currently, 26% of the world's 7,745 remaining local livestock breeds are believed to be at risk of extinction, and an estimated 33% of fish stocks are overfished (Jones, S.K., Carmona, N.E., Juventia, S.D., Dulloo, M.E., Laporte, M.A., Villana, C., remans, R., 2021).

It is well known that biodiversity is under threat for a variety of reasons. As seen in the center of Figure 3.1, the Convention on Biological Diversity (CBD) identifies five principal threats to biodiversity: **Climate change, habitat loss and deforestation, invasive alien species, nutrient loading and pollution, and unsustainable overuse of natural resources** (CBD, 2010; CBD, 2020).

Habitat loss and degradation is the largest single source of pressure on biodiversity worldwide. Habitat loss for terrestrial ecosystems is largely due to the conversion of wild land to agriculture. This accounts for around 30% of land globally. Habitat loss and degradation for inland water ecosystems is largely due to unsustainable water use and drainage for conversion to other land uses such as agriculture and settlement. In coastal ecosystems, a number of factors, including shrimp farms, which often displace mangroves, especially in the tropics, drives some types of aquaculture.

Climate change is already having an impact on biodiversity. The loss of sea ice in the Arctic threatens biodiversity across an entire biome and beyond. The related pressure of ocean acidification resulting from higher concentrations of carbon dioxide in the atmosphere is also already being observed. Climate change and biodiversity loss are inseparable threats to humanity and must be addressed together. Climate change is already affecting biodiversity and is projected to have increasingly greater impacts, with significantly greater risks to natural and human systems in a world warming by 2 degrees Celsius above pre-industrial temperatures compared to 1.5 degrees Celsius above pre-industrial temperatures. Climate change is likely to become the biggest driver of biodiversity loss in the second half of this century.

When considering **pollution and nutrient loading**, pollution from nutrients (nitrogen and phosphorus) and other sources is an ongoing and growing threat to biodiversity in terrestrial, inland water and coastal ecosystems.

As for **overexploitation and unsustainable use**, overexploitation and destructive harvesting practices are at the heart of threats to the world's biodiversity and ecosystems, and there has been no significant reduction in this pressure. Changes in fisheries management in some regions are leading to more sustainable practices, but most stocks still need less pressure to rebuild. Bush meat fishing, which provides an important part of the protein for many rural households, appears to be unsustainable.

Invasive alien species remain a major threat to all kinds of ecosystems and species. There is no sign that this pressure on biodiversity has significantly decreased and there are some indications

that it is increasing. Interventions to control alien invasive species have been successful in some cases, but the threat to biodiversity from new invasions is outweighed.

In addition, there are combined pressures and underlying drivers of biodiversity loss. The direct drivers of biodiversity loss act together to create multiple pressures on biodiversity and ecosystems. Efforts to reduce direct pressures are challenged by deep-rooted underlying causes or indirect drivers that determine the demand for natural resources and are much more difficult to control. Examples of underlying drivers include demographic change, economic activity, levels of international trade, per capita consumption patterns linked to individual wealth, cultural and religious factors, and scientific and technological change.

Another aspect of biodiversity loss is that **human activities** also pose a threat to biodiversity. In other words, the underlying causes of biodiversity loss are broader and largely related to human activities and behaviors (Gwinner and Neureuther, 2018). As mentioned before, in the circular area outside the center in Figure 3.1, overconsumption habits, population growth, unsustainable agricultural production, loss of traditional methods, and underutilization of native species lead to biodiversity loss. For instance, The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2018) report notes that the underlying drivers of land degradation are high-consumption lifestyles in the most developed economies and increased consumption in developing and emerging economies. High and increasing per capita consumption, reinforced by continued population growth in many parts of the world, can trigger unsustainable levels of agricultural expansion, natural resource and mineral extraction, and urbanization - typically leading to higher levels of land degradation.

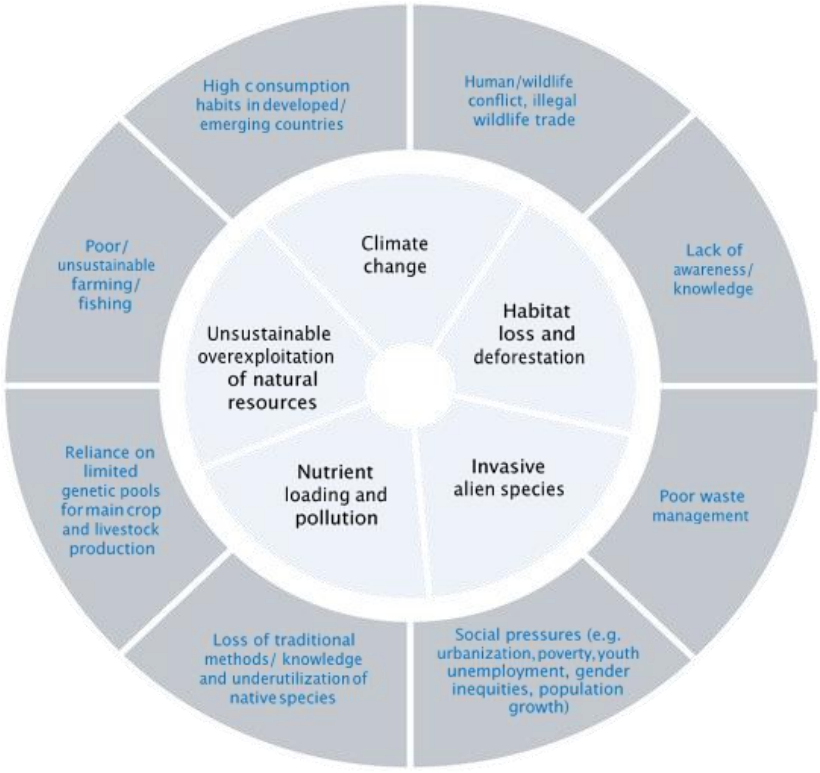

Figure 3.1 The Causes of Threats to Biodiversity (Gwinner and Neureuther, 2018).

Trends from available indicators show that the state of biodiversity is declining and pressures on it are increasing. Furthermore, the benefits that people derive from biodiversity are declining, while responses to address its loss are increasing. The overall message from these indicators is that despite many efforts worldwide to conserve and sustainably use biodiversity, the responses so far have not been sufficient to address the scale of biodiversity loss or reduce the pressure (CBD, 2010).

Indeed, the strategy adopted in 2010 to guide global action during the United Nations Decade for Biodiversity 2011-2020 recognized the need to address the underlying drivers that influence direct pressures on biodiversity. The Strategic Plan for Biodiversity 2011-2020 structured the 20 Aichi Biodiversity Targets around five strategic goals, setting benchmarks for improvements across drivers, pressures, the state of biodiversity, the benefits derived from biodiversity and the implementation of relevant policies and enabling conditions. Humanity stands at a crossroads in terms of its legacy for future generations. Biodiversity is declining at an unprecedented rate and the pressures driving this decline are intensifying. None of the Aichi Biodiversity Targets will be fully achieved, threatening the achievement of the Sustainable Development Goals and undermining efforts to combat climate change (CBD, 2020). To give another example, one of the targets states that by 2020, agriculture, aquaculture and forestry will be sustainably managed to conserve biodiversity. In recent years, there has been a significant increase in efforts to promote sustainable agriculture, forestry and aquaculture, including farmer-led agroecological approaches. Fertilizer and pesticide use has stabilized globally, albeit at high levels. Despite this progress, biodiversity continues to decline on land used to produce food and timber; food and agricultural production remain among the main drivers of global biodiversity loss. It therefore concludes that this target has not been achieved.

3.2 Promoting Biodiversity in the Future

Reversing biodiversity loss requires a combination of nature conservation and a shift to sustainable food production and consumption (WWF, 2021). Research studies provide insights into solutions in the context of agriculture for biodiversity, where agriculture is recognized as a driver of biodiversity. Figure 3.2 and Figure 3.3 address the drivers of biodiversity through a combination of technical and socio-economic solutions. These solutions harmonize agriculture with the natural environment to conserve and enhance the biodiversity of plants, animals and microbes on the farmland.

Technical solutions emphasize sustainable practices for land use management that promote the natural balance and benefits of biodiversity (Figure 3.2). Land degradation and fragmentation are at the heart of habitat loss that threatens biodiversity. Solutions focus on protecting or restoring land, water or forest systems. Solutions use a variety of methods to improve natural resource management, replacing the overuse of chemical fertilizers and pesticides with organic farming, integrated farming and conservation agriculture, and restoring ecosystems. Better control of waste and crop residues is addressed, including turning them into compost, animal feed or biofuel. The solutions also promote alternative pest control, fertilization and waste management to protect water resources and ecosystems. They address human/wildlife conflicts and introduce livestock control measures to protect both flora and fauna (Gwinner and Neureuther, 2018).

At the farm level, agroecology is mainly concerned with the establishment of sustainable production practices. Many of these practices improve food production while increasing biodiversity. These include minimizing soil degradation and tillage, nutrient cycling, natural pest management, water conservation, mulching, use of (green) manure, crop rotation, cover and complementary planting, reduced use of synthetic pesticides and mineral fertilizers, lower animal densities, managed and free grazing, crop diversification, nutrient balancing, recovery and reuse, and incorporation of landscape elements such as hedgerows and flower strips (WWF, 2021). Landscape is a socioecological system, the result of the interaction between nature and culture within a geographical area. Increasing the positive impacts of agriculture on biodiversity in a more systematic way and reducing its negative impacts requires a landscape perspective.

More precisely stated, land use change resulting from the expansion of agriculture is the biggest cause of biodiversity loss. Many agricultural practices such as tillage, fertilizer use and pesticide use, as well as the overuse of antibiotics in livestock, also tend to reduce biodiversity. Increasing biodiversity in agroecosystems will contribute to both the sustainability and productivity of agriculture. In this manner, The Convention on Biological Diversity (CBD) proposed to redesign agricultural systems with agroecological and other innovative approaches to increase productivity while minimizing negative impacts on biodiversity (CBD, 2020). CBD also provides key components of the transition stated below:

- Promote integrated pest and disease management. This requires management of the crop and integrated agroecosystems, including, as appropriate, biological control agents, replacement of pesticides with non-toxic alternatives, elimination or reduction of pesticide use and antibiotics.

- Improve land and water management by promoting soil biodiversity through minimum tillage, avoiding pesticides and excessive fertilizers, including through conservation agriculture or organic farming, promoting the efficient use of fertilizers, and promoting efficient irrigation water management.

- Integrating crop, livestock, fish and/or tree production systems for efficiency and ecological benefits, for example through mixed crop and feed systems, improved grazing management and aquaculture integrated into farming systems; ensuring animal health and welfare.

- Conserve biodiversity in agro-ecosystems by promoting diversity within and among plants, animals, fish and trees on farms and through conservation and breeding programs, protect pollinators and natural enemies of pests, increase soil biodiversity.

- Promote on-farm learning and research through farmer networks, farmer field schools, participatory plant breeding and research, supported by investments in research and extension services.

- Improve linkages between farmers and consumers, through local markets and supply chains.

- Providing an enabling environment, taking into account the environmental, health and social externalities (both positive and negative) of agriculture and food systems, by promoting and guiding policies, subsidies and incentives to support sustainable agricultural practices that enhance biodiversity.

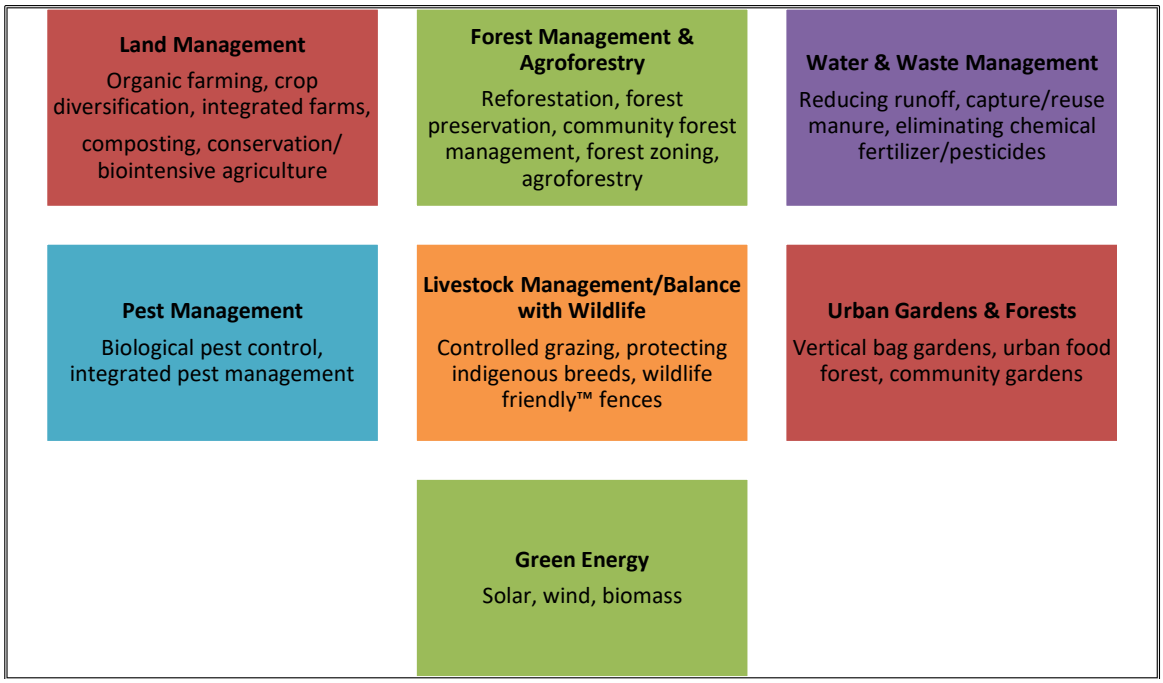

Figure 3.2 Technical Solutions for Promoting Biodiversity (Gwinner and Neureuther, 2018).

To address the human drivers of biodiversity loss, most solutions use strategies that incorporate key social and economic development elements (Figure 3.3). Therefore, socio-economic solutions bring new economic benefits and recognition for traditional varieties, knowledge and practices (Gwinner and Neureuther, 2018). As older generations are often seen as the primary custodians of biodiversity, or "seed keepers", programs that promote the traditional and intergenerational transmission of indigenous seeds, breeds and knowledge target them. Solutions also celebrate the potential of young people and women farmers to drive change. Maas et al. (2021) found that low-educated male and conventional farmers perceived environmentally friendly or science-based agricultural management and decision-making processes as less important compared to scientists and highly educated female and organic farmers. This result highlights important opportunities for more targeted cooperation and communication measures to advance agricultural biodiversity conservation. Therefore, women and youth are particularly recognized as agricultural agents of change and are offered projects that offer them leadership and skills development, job creation and diversification of livelihoods, and ways to better value their contributions. Many programs integrate economic incentives to reward methods that conserve biodiversity and add value to their production, such as collaborating with chefs and businesses to use and market traditional and underutilized species as gourmet foods and natural medicines (Gwinner and Neureuther, 2018).

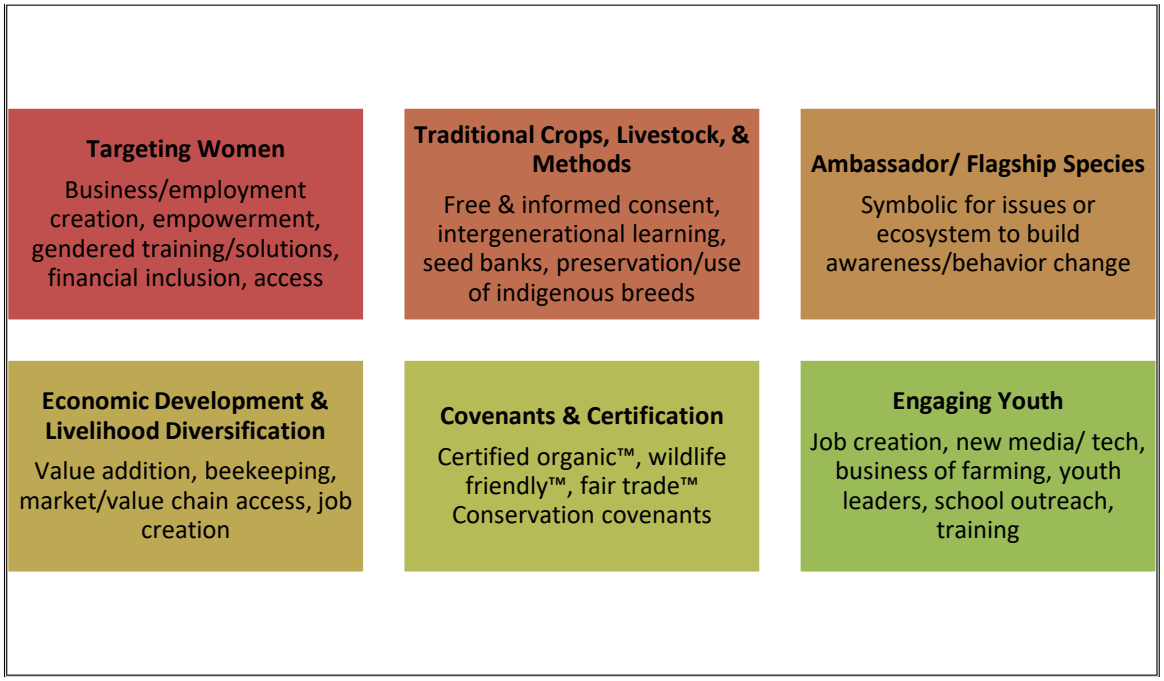

Figure 3.3 Social and Economics Solutions for Promoting Biodiversity (Gwinner and Neureuther, 2018)

Although the instruments may appear to be different, the underlying goals for protecting and promoting biodiversity in the future are similar. To guide the way, the Convention on Biological Diversity has identified five strategic objectives, as set out below (CBD, 2010):

a) Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society.
b) Reduce direct pressures on biodiversity and promote sustainable use.
c) Improve the state of biodiversity by protecting ecosystems, species and genetic diversity.
d) Enhance the benefits of biodiversity and ecosystem services for all.
e) Enhance implementation through participatory planning, knowledge management and capacity building.

The available evidence shows that while the targets of the Strategic Plan for Biodiversity 2011-2020 have not been achieved, it is not too late to slow, halt and ultimately reverse the current trends of biodiversity decline (CBD, 2020). Moreover, the actions needed to achieve this turnaround are fully aligned with the goals and targets set out in the 2030 Agenda for Sustainable Development and the Paris Climate Summit Agreement on Change. In summary, the realization of the 2050 Vision for Biodiversity depends on a portfolio of actions in the following areas, each of which is necessary, but none of which is sufficient on its own:

a) Efforts to conserve and restore biodiversity need to be mainstreamed at all levels, using approaches that depend on the local context.
b) Efforts to keep climate change well below 2 degrees Celsius and 1,5 degrees Celsius above pre-industrial levels are essential to prevent climate impacts from overwhelming all other actions to support biodiversity.
c) Effective action is needed to address all other pressures causing biodiversity loss, including invasive alien species, pollution and unsustainable exploitation of biodiversity, particularly in marine and inland water ecosystems.

d) Transform the production of goods and services, particularly food. This will involve adopting farming methods that can meet growing global demand while having less negative impact on the environment, and reducing the pressure to convert more land into production.
e) Similarly, transformations are needed to limit the demand for increased food production by adopting healthier diets and reducing food waste, as well as limiting the consumption of other material goods and services that affect biodiversity, such as forestry, energy and freshwater supply.

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4. Causes and Conditions That the Cultivation and Consumption of Numerous Crops (Legumes, Vegetables) were Altered and/or Completely Eliminated

Neglected and underutilized crops, also referred to as 'orphan' species are defined as: 'non-commodity wild or cultivated plant species, including crop wild relatives, that were once popular but have since been neglected by mainstream agriculture due to a range of agronomic, genetic, economic, social, and cultural reasons' (Mabhaudhi et al., 2022). Orphan species are predominantly grown by resource-poor farmers, primarily women, who use their own seeds on small landholdings in specific agro-ecological niches and on marginal and sub-marginal lands to supply families with high nutritional value food (Lambein et al., 2019). These plants are also used as animal feed and in other agricultural applications generating income for resource-poor farmers (Foyer et al., 2016). However, due to their lack of economic importance, most of these plants have been neglected by the international scientific community and industry when compared to commodities such as rice, wheat, and maize. Most of these crops are usually marginalized, or entirely forgotten by breeders, farmers, researchers, and policymakers. Additionally, what often happens is that a plant well-recognized as a main crop in one country, at the same time becomes a neglected minor crop in another country (Padulosi et al., 2013).

Over the recent years, more, and more attention is devoted to underutilized and neglected crops/plants due to their recognized potential to reduce risk in agricultural production systems, improve human nutrition and health, generate income, and be used as medicine, strengthen ecosystem health and support cultural diversity. Before we can bring the neglected species 'back to a plate', we need to understand the most important reasons that contributed to the problem and find potential solutions for overcoming the identified obstacles.

In this chapter, potential reasons, causes, and conditions, for abandonment of certain species are discussed, together with a presentation of case studies including the following species: buckwheat, lentils, green leafy vegetables, dandelion, grass pea, cucumber melo, and eggplant.

The main reasons for altered and/or eliminated cultivation and consumption of crops of interest are identified and summarized at the end of this chapter. Finally, based solely on the presented data, potential solutions for overcoming identified obstacles related to both cultivation and consumption of some beneficial underutilized crops and neglected species are presented.

Causes and Conditions for Altered or Eliminated Use of Certain Plants

There are about 30.000 edible plant species identified worldwide, of which more than 7.000 are cultivated for food. At the moment, less than 150 species are commercially produced, and around 100 crop species provide close to 90% of the calories in the human diet while an impressive 60% of the human energy supply is provided by four plants only, i.e., rice, wheat, maize, and potato (Li and Siddique, 2020). Hence, a significant number of plant species remain underutilized.

Underutilized crops (also termed neglected, orphan, promising, minor, or little-used) are mostly wild or semi- domesticated species tailored to local environments. When more productive crops

became available in farming systems, many traditional foods, that were used for centuries prior to it, became increasingly abandoned. Agro-technical, policy, and institutional perspectives and socioeconomic factors contributed to their underutilization. An extensive monoculture, agricultural modernization and inclination toward more high-yielding varieties were the main reasons for the underutilization of certain beneficial plants (Padulosi et al. 2013).

Conventional agriculture prefers monoculture, high input high output model, which reduces biodiversity, makes farming more susceptible to environmental shocks, and leads to a global ecological imbalance. Since the 1900s more than 75% of genetic diversity has been lost (Gregory et al, 2019). This further lead to the dependence on a few staple crops and creates a threat to food security, unbalanced diets, and ultimate malnutrition of most vulnerable populations such as children, women, smallholder farmers, and indigenous people that depend on these traditional crops for food (Wolfe, 2000). Extreme monoculture reduced genetic differences within varieties.

Politically, governments give priority to the production of high-yielding crop plants and provide subsidies for major crops only. A few major crops take over national and international markets and government policies. Green Revolution focused on several major crops only while all others traditionally used species become marginalized, besides their important pro-livelihood and adoptive characteristics (Cheng et al., 2018). The lack of a natural environment favorable to production, processing, distribution, marketing, and consumption added an extra burden to the existing problem (Li and Siddique, 2020). Therefore, both political and economic reasons resulted in a rapid loss of traditional crops, before they were even fully described, researched, and promoted. As a consequence, underutilized plants become under-domesticated and were produced in home gardens or on small blocks of land, with a limited opportunity to make improved landraces or ecotypes (Padulosi et al. 2013).

Climate changes, i.e., variations in temperature and rainfall patterns disrupt conventional agriculture systems that require relatively uniform conditions, thus traditional farming systems in marginal and remote areas turn out to be most affected (Mabhaudhi et al., 2022).

Stigmatization, a negative image of 'food of the poor' was an additional factor that led to reduced production and consumption of some crops. Traditional and wild relatives of crops were often seen as old-fashioned, linked to the rural poor, especially in the eyes of recently urbanized populations in developed countries (Gregory et al, 2019).

Furthermore, forgotten plants remain forgotten as people are uncertain of how they can be used as food (Gregory et al, 2019). Some of the reasons that these foods are disappearing are the following: demographic shift complemented by dietary changes, the long preparation time and advanced age of people who knew how to prepare these foods, limited supply of the forgotten foods and lack of innovative postharvest and processing technologies (Gregory et al, 2019). However, the value placed on traditional medicines and health remedies increased the demand for these plants. Most crop species harvested from the wild are believed to be scarce herbal medicinal plant species, and as such, there is a need for some of these plants to be more commonly cultivated and utilized. Agrobiodiversity is a crucial element of substantial agriculture and forgotten plant crops are the key components of such a system that could be used to meet increased food requirements worldwide (Madhaudhi et al., 2019). Underutilized crops have endured even without formal support, which implies that they contain some desirable traits that could be useful for building resilience and adaptation to climate-changing environments (Madhaudhi et al., 2019). Utilization of orphan crop cereal species, more resilient to certain

climates and environments is crucial in agronomic crop productivity in terms of both nutrient quality and yield (Wolfe, 2000).

Considering the scope of the BioValue project the following underutilised crops were analysed: **Buckwheat, Dandelion, Grasspea, Eggplant, Cucumber melo var. Flexuosus, Lentils and Green leafy vegetables.**

4.1 Buckwheat

The origin center for buckwheat cultivation was Middle Asia, later transferred to Central and Eastern Europe by nomadic people (Nalinkumar et al., 2020). In Europe, buckwheat gained a reputation and was extensively used within the 13th century in Italy, Germany, and Austria, and it remained very popular until the early 20th century. However, due to the cultivation and expansion of other cereals, specifically common wheat (Triticum aestivum), buckwheat slowly lost its importance and become a neglected plant (Mir et al., 2018).

Many different species of buckwheat are grown worldwide, but only two are used as food: tartary buckwheat (Fagopyrum tataricum) and common buckwheat (Fagopyrum esculentum Moench.) (Domingos et al., 2021).

Cultivation of buckwheat is convenient with strong potential as it demands minimal resources and can be grown in poor and marginal soils. A short period of growth and the ability to sustain in any climatic environmental stress situation are contributing additionally to the self-compatible nature of buckwheat (Nalinkumar et al., 2020). Yet, due to the tightly adhering hull and bitter taste, buckwheat became a minor crop in many European countries, with the exception of Ukraine, Poland, and Russian Federation (FAOSTAT, 2019).

A major limitation to continued cultivation of this plant was a limited number of buckwheat plant varieties and the fact that seeds ripen asynchronously causing a diminished rate and percent of germination leading to unsatisfactory grain yield (Domingos et al., 2021). Consequently, farmers lost interest in cultivating buckwheat and turned their attention to cereals that could provide extra yield and additional profit (wheat, maize, and rice).

In addition, the green revolution, contributed to genetic multiplicity in the agricultural field. The growing population and an increased need for food security and economic stability lead to the implementation and technological interventions intended for the cultivation of high demanding crops (Nalinkumar et al., 2020). Numerous factors prohibit extensive cultivation and inclusion of buckwheat into the modern food system: agronomic factors (growth, yield), technological (genetic factors, processing of seeds), social (low esteem; lack of awareness), as well as economic (marketing restraints) (Pirzadah and Malik, 2020).

Agronomic drawbacks are one of the major obstacles that hinder the widespread production of buckwheat. There is an insufficiently characterized agronomic evaluation of buckwheat plants compared to newer crops. On-farm management of buckwheat germplasm has been initiated worldwide, but comprehensive reports regarding the same are still scarce apart from studies in South-West China and the Indian Himalayan region (Singh et al., 2020). The knowledge of the production, yield, and other quality traits of buckwheat mainly comes from low-input systems which limits our capability to measure its actual potential (Nalinkumar et al., 2020). Similarly, there are certain limitations at the genomic level, for instance self-incompatibility in buckwheat that reduces its breeding and trait improvement. The seed shattering and flour abortion limit

buckwheat yield production (Pirzadah and Malik, 2020). Besides, transformation and mutagenesis have not yet been established or adjusted, so there is still a dependence on natural variation for breeding purposes.

Furthermore, the existence of allergenic compounds impedes buckwheat recognition amongst the farmers (Indian et al., 2021). The lack of focused crop improvement efforts compared to major cereal crops is a constant downfall for more common buckwheat production. Conventional breeding of buckwheat has not been achieved due to several reasons: unsynchronized flowering, an innate out-breeding mechanism (self- incompatibility) unique to common buckwheat and a low seed yield (Joshi et al., 2019). Strong self-cross incompatibility inhibits traditional breeding attempts (Kumari and Chaudhary, 2020). The indeterminate growth, flowering, low seed sets, imperfect reproductive organs, failure of fertilization, and vulnerability to both spring and fall frosts are well-known obstacles to the cultivation and consumption of this valuable plant (Kumari and Chaudhary, 2020).

Buckwheat has an immense nutraceutical potential, but the term 'underutilized crop' is still associated with it. There are several improved varieties of buckwheat that could be sustained under wide environmental conditions. The desirable agronomical traits of buckwheat that should be enhanced are seed size, resistance to seed lodging and shattering, maturity, and easier dehulling (Kumari and Chaudhary, 2020). Conventional farming systems are of paramount importance for the conservation of genetic diversity together with a sustainable livelihood and food security (Singh et al., 2020).

The higher demand for gluten-free diets experienced during the last few years helps in bringing this and similar plants back to cultivation. Nutritional and health benefits of buckwheat should be promoted and with an increased awareness of its potential advantages, this plant could be slowly put back into cultivation and consumption.

Buckwheat: Bitter taste, tightly adhering hull, only two species used for human consumption, expansion of other cereals, i.e., wheat, rice, and maize; the presence of allergenic compounds, self-incompatibility, vulnerability to both spring and fall frosts, insufficiently characterized agronomic evaluation of buckwheat plants.

4.2 Dandelion

An interest in growing so-called 'wild edible greens' varies from region to region, from one country to another. Reichardia picroides and Taraxacum officinale are Asteraceae family species with limited information on their agronomic practices related to harvesting, fertilization regimens, growing period, cropping under different environmental conditions, and cultivation systems (Alexopoulos et al., 2021).
There is still insufficient information available as to how to improve the yield of these crops without losing the food safety and nutritional quality of the final products, as most of these species are only grown in the wild or encountered as weeds within the field.
However, these plants are promising solutions toward sustainability and increased agrobiodiversity as they are tolerant to arduous conditions and can be adapted easily to climate changes. These foods are used as an integral partof local cuisines and for medicinal purposes in areas where they grow (Ceccenti et al., 2018). The commercial cultivation of such species has gained interest both by farmers and consumers, due to the potential of using wild edible species in sustainable cropping systems to produce high-value-added products with increased health

beneficial effects (Alexopoulos et al., 2021). Further efforts should be addressed towards enhancing knowledge on the cultivation and consumption practices of these species to ensure their broader implementation and utilization.

Dandelion: Limited information on agronomic practices and cultivation characteristics, lack of awareness of beneficial aspects of these plants, and lack of culinary skills for the preparation of products based on these plants.

4.3 Grass pea

Grass pea (Lathyrus sativus L.) is one of the eldest cultivated crops with a prolonged history of domestication. It is a typical orphan legume crop (Cullis and Kunert, 2017). The seeds were found in the oldest excavations in India and Turkey in 2500 BC and later in the Balkan region in 8000 BC (Lambein et al., 2019). Grass pea was present in the funeral offerings found in the Egyptian pyramids. It was considered a special food offered to kings. Soon after, these crops were spread to the temperate Mediterranean region and further to tropics and sub-tropic regions in the northern hemisphere, East Africa, South Asia, and South America (Ramya et al., 2021).

Grain legumes and cereals were present in the diets of ancient civilizations in the Middle East and America delivering a well-balanced composition of essential amino acids. Food prepared from grass pea has been very popular in South Asia (Nepal, India, and Bangladesh) and many European countries (Italy, Spain, Portugal, Poland, and France) and in Africa (Ethiopia) (Lambein et al., 2019).

However, today grass pea is almost an entirely forgotten plant, produced in very small quantities, and mainly used during some religious celebrations (Cullis and Kunert, 2017). In addition, the reputation of grass pea has changed substantially, and grass pea is often seen as a subsistence food for the poorest of the poor (Ramya et al., 2021). Abandonment in cultivation and production caused a lack of genetic improvement, which contributed to lower yield in terms of both quality and quantity (Cullis and Kunert, 2017).

Neurolathyrism, a neurodegenerative syndrome resulting in the paralysis of lower limbs, has been associated with the consumption of grass pea seeds (Ramya et al., 2021; Xu et al., 2017). The disease is caused by the toxin β-N-oxalyl-L-α, β- diaminopropionic acid (β-L-ODAP), also known as Noxalyl- amino-L-alanine (BOAA) or dencichine (Emmrich et al., 2019).

The cultivation of this crop was a source of discussion between agricultural scientists, nutritionists, and farmers for decades due to its bad reputation. However, while, a negative connotation of 'lathyrism' exists since 1873, a disorder occurs only when the primary component makes 30% of the total caloric intake and when grass pea is consumed as a sole food for more than three to four months (Xu et al., 2017).

The β-L-ODAP is found in all parts of the plants, with the highest concentrations measured in the embryo at the reproductive stage and in the leaf at the vegetative stage (Xu et al., 2017). A lack of appropriate assays to screen large populations of grass pea accessions or mutants restricts the development of low-β-L-ODAP varieties (Emmrich et al., 2019).

The main convenience of grass pea lies in its tolerance to abiotic stresses, i.e., flood, waterlogged, salinity, and drought (Lambein et al., 2019). Despite enormous achievements and rapid advances

in genome sequencing technologies, particularly, next-generation sequencing, genomic information related to grass pea is still missing (Jha et al., 2022). So far, very limited research has been carried out towards identifying possible ways for reducing the presence of b-ODAP and improving the nutritional content of this essential legume plant (Mekonen et al., 2022).

Additional research should be implemented towards better understanding the genomic sequence of grass peas, identifying potential ways to produce low-level b-ODAP plants and incorporating this protein-rich plant into more common cultivation and consumption.

Grass pea: 'Food of the poorest of the poor', neurolathyrism, absent genome sequence

4.4 Eggplant

Eggplant (Solanum melongena L.) is referred to as an 'old world crop' domesticated in Asia, Africa, and Europe. The archeological evidence indicates that the utilization of wild eggplants has been initiated in India and later in China, with a consequent additional and independent center of domestication in the Philippines. During the eighth century, eggplant spread westward along the Silk Road into Western Asia, Europe, and Africa and eastward to Japan. Likewise, the plant was introduced into America shortly after Europeans arrived there and soon after expanded into other parts of the world.

These days, eggplant is mostly used in Africa, the subtropics (India, Bangladesh, Central America), the Middle East, and Southeast Asia. It is also cultivated in several warm temperate regions such as the Mediterranean and Southern USA.

Solanum is a large genus with over 1400 species, among which several members are poisonous to humans, such as S. dulcamara L. (the nightshades). There are two well-cultivated brinjal or aubergine eggplant species (Solanum melongena L.), and two other underutilized eggplant species, the African eggplant (S. macrocarpon L.) and the scarlet eggplant (S. aethiopicum L.), also cultivated with local significance (Oladosu et al., 2021). The domestication of species cultivated in Africa, i.e., the gboma eggplants (S. Macrocarpon L.) and scarlet eggplant (S. aethiopicum L.) is less known (Taher et al., 2017).

Eggplant has a rather long growth period, so it is more exposed to a broad array of plant diseases (i.e., bacterial wilt, fusarium wilt, anthracnose fruit rot, verticillium wilt), weeds, pests (i.e., mites, whiteflies, aphids) and nematodes compared to other vegetables (Medakker and Vijayaraghavan, 2007). Yield and fruit quality is reduced by unpredictable weather conditions with extreme temperatures, drought, or flooding (Taher et al., 2017).

The leaves and fruits are most commonly used for food and medicinal purposes. After tomato, potato, chili, and tobacco, eggplant is the fifth economically most valuable vegetable of the Solanaceae family. Still, little progress has been made in the production of cultivated eggplants, based on the information obtained from wild species, mainly due to the lack of information on genome sequences (Oladosu et al., 2021). The wild relatives are regularly the major sources of biotic and abiotic tolerance alleles, so they should be used whenever possible. But the progress of genome-anchored markers necessary for successful trait transfer using marker-assisted selection is in this case was precluded by the absence of a genome sequence for wild relatives. Improved eggplant varieties are needed for sustainable production and adaptation to climate changes (Taher et al., 2017). The aim of the current eggplant breeding programs is the development of

higher-yielding varieties with high fruit quality, shelf-life, and resistance to major disease and insect pests, with a wide-ranging adaptation to environmental stresses.

Eggplant: increased exposure to plant diseases and insects; absence of genome sequence

4.5 Cucumber - Cucumis melo var. flexuosus (Armenian cucumber)

The earliest data on cultured Cucumis melo are present in Egyptian mural paintings. Cucumber is a vegetable identified in the bible as being eaten by the Hebrews in Egypt (Swamy, 2018). Extensive documents on the use of Cucumis melo are found in ancient Chinese writings from about 2000 BC., and Roman and Greek documents from the first century BC. (Flores-León et al., 2021). The sweet melon forms were not known in the Roman period and were imported from Persia or Caucasus by travelers, making their arrival in Europe around the 13th century (Swamy, 2018). Cucumis melo isn't a cucumber, it is a variety of muskmelon, also known as yard- long cucumber or Kakdi or snake melon. It is believed to be native of Armenia, or somewhere nearby, as Iran. The plants can grow to 36 inches (circa 90 cm) long, and they do taste like cucumbers (Swamy, 2018).

In spite of the fact that melo is a neglected crop, snake melons are still frequently cultivated in many African, Asian, and Mediterranean countries, known by different local names such as Armenian cucumber, Cucumaru, Hiti, Fakous, Kakri, or Mekte (Flores-León et al., 2021). Many local landraces have been conserved in Spain, mainly in eastern coastal regions (Murcia, Valencia, Alicante), and are used for self-consumption. This nonaromatic fruit is long nonsweet usually eaten as pickled or fresh vegetables. They are used like cucumbers in many traditional recipes because of their appearance and taste and are also utilized as conventional medicine (Flores-León et al., 2021). The short shelf life of the fruits, much shorter than that of the cucumbers, limits their commercialization in remote markets. In addition, this crop is threatened by harsh genetic erosion (Swamy, 2018). Melons genotypes vary in quality and productivity driving traits such as total yield, resistance to main pest diseases (i.e., powdery mildew), and number of fruits per vine (Ilahy et al., 2020). Fungal diseases are similarly affecting both open field and greenhouse-grown plants. While fungal species produce more virulent strains, breeders and farmers are trying to find ways to grow more resistant melon genotypes. Several limiting factors for melon organic farming need to be resolved to be economically sustainable, examples are reduced yield and yield stability. Pests and diseases are additional factors contributing to the loss of productivity, and the application of agrochemicals is inadequate. An additional challenge is the fact that the local production is confined to marginal lands where abiotic and biotic stressful conditions arise (Flores-León et al., 2021).

All these factors should be addressed to promote the cultivation of cucumber melo and improve plant diversity with an aim of providing nutritionally rich cultivars with distinct health benefits.

Cucumis melo var. Flexuosus: Threatened by severe genetic erosion, short shelf life, pest diseases, fungal diseases, biotic and abiotic stressful conditions.

4.6 Lentils

Cultivated lentil was initially domesticated in western Asia around 2000 BC., and after that spread to Egypt, central and southern Europe, the Mediterranean, Pakistan, China, Ethiopia, India, Afghanistan, and later to Latin America, Argentina, Colombia, Mexico, and finally to Canada

(Matny, 2015). Lentils provided a cheap source of dietary proteins to rural and urban families in ancient times (Paffarini et al., 2021).

Nowadays, lentil is an important pulse crop cultivated in most subtropical regions, the Indian Subcontinent, Southern Europe, Middle East, North and South America, Northern Africa and East Africa, Australia, and West Asia. Its production accounts for 27% of the total crop production worldwide (Coyne et al., 2020). The USA, Nepal, China, and Ethiopia, Turkey, Australia are the major lentil-growing countries in the world. The major sites of the increased global production are India and Canada (Matny, 2015).

Besides being important for feeding the human population, lentils are valuable for providing beneficial ecosystem services such as green manuring, nitrate capture, and maintenance of soil fertility. Lentils are cultivated and consumed in many European countries but in different ways. Regional food habits and traditions determine the consumption patterns of lentils (Paffarini et al., 2021).

However, lentils are still considered neglected and underutilized crops. Legume yield capacities have been limited because of its demotion to marginal lands where numerous abiotic stresses frequently occur, for instance, short growing seasons, poor soils, and water limitation (Coyne et al., 2020). As lentil plants have weak stems and an undefined growth rate, they need a companion crop. Monocropping systems that are used in the dry regions of the Mediterranean are not appropriate in this instance. The cultivation of lentils is complex in comparison to other crops, as successful mixed system cultivation of lentils and companion crops, usually cereals, is affected by many factors. The relations between lentils and their companion crop can be both negative and positive (Reif et al., 2020).

Lentil production in humid areas is also challenging, heavy rain causes the frequent lodging of lentil plants, reduces the plants' distance to the ground, and consequently the amount of yield of local lentil farmers, which is in most cases low (Reif et al., 2020).

Therefore, the cultivation of lentils was reduced, due to the increasing superiority of other crops, such as cereals, that could be grown on marginal land and benefit from chemical-synthetic crop protection and mineral fertilization. As lentils lost their economic importance, breeding, and development of high- performance lentil varieties appropriate for humid climates stopped. Based on the Statistical State Office of Baden-Württemberg data in Germany, the cultivation of lentils had almost completely vanished by the middle of the 20th century (Reif et al., 2020). Local cultivars had low yields and were very susceptible to several stressors and diseases.

The production was affected by both biotic (weeds, diseases, insects) and abiotic (drought, soil fertility, and temperature) stressors (Matny, 2015). Likewise, low grain quality was also evident, small-seeded, undesired color, and low plumpness seeds were produced.

Additional yield-reducing factors are slow to leaf area development, lack of seedling vigor, high rate of flower drop, poor dry matter, low harvest index, low pod setting, low or no response to inputs, and lack of lodging resistance (Matny, 2015). The time-demanding processes for cleaning, separating, and drying made lentil cultivation less appealing in comparison to their companion crops. Furthermore, disease is a major threat to lentil production which at times produced a total crop failure.

In Ethiopia, a new variety of lentils for the low land dry areas has been developed, but again, it was not always possible for researchers to provide these varieties to farmers as Ethiopian farmers like to keep the seeds. In addition, due to an increased incidence of disease and insect problems, a small percentage of growers (below 10%) adopted new and improved varieties (Coyne et al., 2020). Rust, root rots, and Fusarium wilt are the major pests of lentil plants (Matny, 2015). The breeding of more resistant varieties helped in the cultivation of lentils free from diseases and consequently the willingness of farmers to grow and cultivate lentil crops increased. This positive trend should be continued in the future and expanded to other counties worldwide.

Lentils: relegation to marginal lands, abiotic and biotic stresses, water limitation, diseases, pests, low yield, low productivity, production constraints, complex cultivation, technical challenges, superiority of other crops (cereals).

4.7 Leafy Vegetables

A wide range of wild varieties of leafy vegetables, roots, tubers, fruits, and stems are harvested because of their taste and health benefits, cultural uses, as food supplements, or to tide over food shortages. These plants are an integral part of local food habits, useful in ensuring household food and income security. Leafy vegetable plants are an important dietary component, rich in several different vitamins like folic acid, vitamin C, and vitamin A and minerals, i.e., potassium, magnesium, iron, zinc, and calcium. Green leafy vegetables contain health promoting phytochemicals, known to have an important role in alleviation and fighting against many deficiencies and diseases (Chacha et al., 2020). The consumption of vegetables has been associated with decreased risk of developing various diseases including heart ailments and malignancies, pointing out the benefits of their increased intake.

The taste, bitterness, and absurd tastes and smell were among the main reported issues for reduced consumption of underutilized vegetables. The decline in their production and consumption among various communities is to an extent due to the introduction of exotic vegetable varieties, that are more affordable, grown without fertilizers or pesticides, organically, and can be used not only as a food but as medicine also (Chacha et al., 2020). New exotic varieties did not have a negative connotation linked to them, they were not considered primitive foodstuff or a poor man's diet. Those who consumed underutilized varieties were often perceived as old-fashioned and primitive.

Short shelf life and quick deterioration in quality, flavor, and nutritional content were additional reasons for poor utilization of some forgotten green leafy vegetables. The inability to maintain freshness for longer periods was the major obstacle for farmers who wanted to increase marketing opportunities and capacity to advertise and sell underutilized vegetable species (Chacha and Laswai, 2020). Further work should be devoted to identifying potential ways for overcoming the obstacles related to the taste and smell of these foods and invest in recognizing innovative ways of preparation and cooking that will minimize the unpleasant characteristics. Additional investments should be made towards identifying the most suitable storage arrangements that will ensure maximum conservation of the nutritional potential of these valuable vegetables.

Leafy vegetables: increased cultivation of exotic varieties, bitterness, and unpleasant taste and/or smell, misconceptions 'poor man's diet', short shelf life.

4.8 Summary of Major Findings

The main reasons for altered and/or eliminated consumption and cultivation of crops of interest can be classified into several categories: agronomic, social, technological, economic, and political. The most important identified factors are listed below:

1. Problems with production and harvesting, yield, land usage, seeds availability, processing of seeds
2. Biotic factors: insects, diseases, and weeds
3. Abiotic issues: temperature, soil fertility, waterlogging, drought
4. Presence of toxins and allergenic compounds
5. Agronomical traits, germplasm collection, genetic factors, the limited number of species used as food
6. Poor economic competitiveness of underutilized compared to staple crops
7. Green revolution issues, self-incompatibility of certain plants
8. Absence of genome sequences for certain crops
9. Inefficiency in producing, storing, and processing of these crops
10. Disorganized or non-existing food supply chains
11. Expansion and cultivation of more common higher yield cereal crops, monocultures
12. Increased cultivation of so called 'exotic' varieties
13. The lack of sound baseline data on the nutritional and health-protective/promoting properties of these foods
14. Lack of culinary skills for the preparation of products based on these plants
15. Unaccustomed taste of these foods, non-popular recipes
16. Negative associations with a poor rural lifestyle and low social status, negative cultural stereotypes against these traditional foods, like "this is what poor people eat"
17. The lack of policy recommendations
18. Marketing constraints, short shelf life
19. Political and economic reasons

4.9 Potential Solutions and Recommendations for Overcoming Identified Barriers

Based on the data provided within this review several different strategies could be proposed as potential solutions for the partial or total overcoming of some of the detected obstacles.

1. Use beneficial crop traits for producing more environmentally friendly and fewer stressors affected crop varieties
2. Diminish problems with production, seed availability, harvesting, and processing
3. Enhance the desirable agronomical traits of certain plants as much as possible (i.e., seed size, resistance to various pests and diseases)
4. Develop adequate assays for investigation and elimination of potentially toxic and allergenicsubstances found in certain crops
5. Apply novel rapid technologies for identification of genome sequencing data of neglected species
6. Design appropriate and country-specific policy recommendations for the cultivation of forgottenplants
7. Address existing negative connotations and educate people and increase awareness of the nutritional benefits of underutilized foods and products

8. Create programs for advertising underutilized foods of interest, encourage their use in everyday cooking, promote their use as both food and medicine, and stimulate improvements of culinary skillsof consumers
9. Reduce political and economic neglect of underutilized species as much as possible

In conclusion, this review summarizes the main causes and conditions that contributed to eliminated cultivation and consumption of certain forgotten and underutilized plants. Recognized benefits in reducing the risks in agricultural production systems and potential benefits to human nutrition and health should be the main drivers that will motivate farmers, researchers, breeders, nutritionists, agronomists, and policymakers to bring neglected species back to cultivation.

Reference List of Section 4

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5. Consumption Patterns of Healthy and Environmentally Friendly Foods: An Assessment of Consumer Needs

Encouraging healthy and environmentally friendly food choices is among the challenges of current public health nutrition policies. Understanding factors driving sustainable food consumption patterns is a crucial issue for the future wellbeing of humans, food systems sustainability and the environmental protection. Household food consumption patterns are influenced by numerous factors such as nutritional aspects, economic restrictions, cultural taste and customs, lifestyle and consumer preferences. On the other hand, dietary patterns constitute sources of Greenhouse Gas Emissions (GHG) and are associated with various environmental impacts.

Reinforcing sustainable diets, that based on environmentally friendly foods and changing food consumption habits can reduce the food-related carbon footprint, mitigate the negative impacts of climate change, improve the quality of human life, promote changes in the retail, distribution and marketing functions of business. Increasing demand for organic food can contribute towards this direction, as well. On account of being produced without chemicals and fertilizers, organic food is considered an environmentally friendly food choice.

A pathway towards sustainable food systems is consumer demand for healthier food and the persistence in environmentally friendly food selection. Findings from previous surveys suggest that established attitudes toward climate change and preferences for healthier food products seem to be the key factor to increase social awareness towards environmentally friendly products and to change purchase and consumption behavior.

The descriptive analysis was carried out in the framework of this Deliverable reveals that the research for “Consumption patterns with an assessment of consumer need for healthy and environmentally friendly foods” is of constant interest over time. There are numerous studies highlighted the factors affecting consumer attitude and demand for organics, environmentally friendly foods or healthier foods. Table 5.1 summarizes the findings of the papers that have been reviewed.

Table 5.1 Notable Research on Factors Affecting Consumer Attitude and Demands

References	Topic of Research	Country case
Raptou and Manolas (2022)	Consumption Patterns and Public Attitudes Toward Organic Foods	Greece
Ariani et al. (2021)	Environmentally Friendly Household Food Consumption Behavior	Indonesia
Churak et al. (2021)	Environmental Consequences Related to Nutritional Status of Populations	Thailand
Halicka et al.(2021)	Parental Food Choices Raise Children's Awareness of Sustainable Behaviors	Poland
Esteve-Llorens etal. (2021)	Economic Crisis and Reduction in The Carbon Footprint of Food	Spain
Esteve-Llorens etal. (2021)	EnvironmentalaAnd Nutritional Profile of Food ConsumptionPatterns	Spain
Taghikhah et al.(2020)	Exploring Consumer Behavior and Policy Options in Organic Food Adoption	Australia
Slapø and Karevold(2019)	Set of Eco-Labels to Nugde Customers Toward Most Environmentally Friendly Foods	Norway
Austgulen et al.(2018)	Consumer Readiness to Reduce Meat Consumption for ThePurpose of Environmental Sustainability	Norway
Sulaiman et al.(2017)	Marketing Mix and Consumer Preferences on Healthy Food Consumption	Malaysia
Kim (2017)	Investigation of Behaviours for Encouraging Low-Carbon FoodConsumption	London
Kraus (1015)	Motivators for Consumption of Functional Products	Poland
Onwezen (2015)	The Effect of Emotions on Intention to Buy Organic Food	Netherlands
Casini et al. (2013)	Trends in Food Consumptions	Italy
Avetisyan et al.(2014)	Examination of GGE Associated With Consumption of Domestic and Imported Food	
Chang (2012)	Effect of Eco-Labels on Income Distribution and IncomeInequality of Producers	Taiwan
Salleh et al. (2010)	Consumer's Perception and Purchase Intentions Towards Organic Products: An Exploratory Study	Malaysia
Welsch and Kühling(2009)	Determinants of Organic Food Consumption	Germany
Tsakiridou et al.(2008)	Attitudes and Behavior Toward Organic Products: An Exploratory Study	Greece
Dean et al. (2007)	Perceptions of Healthy Cereal Products and Production Methods	UK, Italy, Finland, Germany

5.1 Findings About Consumer Attitude and Habits For Environmentally Friendly Foods

Reducing the food-related carbon footprint is an important part of climate change mitigation. The key to achieve it is the implementation of an environmentally friendly and healthy diet based on high consumption of plant-based products, limited quantity of animal-origin foodstuffs and low amounts of processed food and added sugars. From the review of literature arises that a wide breadth of papers covers subjects related to consumer food habits and attitudes toward adoption environmentally friendly food consumption and especially for organics that is mentioned to induce less impacts on the environment.

In 2008 Tsakiridou et al., tried to identify consumers' attitudes and behavior towards organic products. The survey based on data collected via questionnaire survey of a non-probability quota

sample of 660 respondents. Data obtained from the survey were analyzed statistically. Descriptive statistics (frequencies, cross- tabulations) and non-parametric tests (Kruskal-Whallis and Mann-Whitney and k-independent samples) were applied to identify the statistical significance of demographic variables to both attitudes and behavior towards organic products. According to the findings, two demographic variables analyzed in the study seem to be highly correlated with organics' attitudes and consumption. Particularly, higher education levels and higher income indicated a strong correlation with organics consumption. In addition, environmental and health concerns are factors that affect preferences for organics' consumption.

Another survey that was associated with attitudes toward climate change and organic food production system, was carried out by Raptou and Manolas (2022). Their survey conducted among 807 adults, were selected via a formal questionnaire in supermarkets and food stores, examined consumption patterns for organic foods. They employed an exploratory factor analysis to reduce the number of variables derived from the survey questionnaire into a smaller set, and a cluster analysis to discrete consumers into different homogenous segments and ascertain common features according to their attitudes toward organic foods and climate change. Furthermore, the ordered probit model was adopted to estimate purchase decisions on organic foods and distinguish among climate change awareness (climate change concerns, climate change skepticism, and activity involvement). Results obtained from the ordered probit model indicate that consumers who acknowledged the benefits of the organic foods production system had a higher likelihood to purchase organics, on a regular basis. Moreover, consumption of organic foods was positively associated with health consciousness and climate change concerns. Additional findings showed that most consumers greatly value the contribution of organic foods to support local economies, lower climate impact and protect the environment.

Similarly, Welsch and Kühling (2009) explored the primary factors behind the shift in the consumer attitude towards organic food. By applying a questionnaire survey and analyzing the results through ordered probit modelling, they outlined the crucial factors have an influence on consumers' decisions for organics. Hence, as favorable factors for purchasing organic food are identified the pro-environmental attitudes (protective actions towards environment), the acknowledgment that environmental problems are exaggerated and the shift towards renewable energy sources.

The discrepancy between consumer intention and buying behaviour for organics gathers interest, as well. Taghikhah et al. (2020) attempted to assess the effectiveness of different policies and informational-education campaigns to influence consumer choices, focusing their research on wine. To understand the factors that affect consumers' willingness to pay for organic wine, they develop a theoretically and empirically grounded computational agent-based model, analyzing results from a previous questionnaire survey. According to their results raising consumer awareness and increasing tax on less environmentally friendly wines it turns out to be more successful in promoting organic wine.

Sulaiman et al. (2017) examined the relationship between the consumer preferences, towards healthy food, with the influence exerts the marketing mix (4P). Their survey was conducted among 400 respondents, consisting of undergraduate students from the University Utara (Malaysia). Various statistical approaches were performed for the analysis of the results, such as independent T-test samples, Pearson correlation and Multiple regression analysis. The results showed a significant and positive relationship between marketing mix (product, price, promotion and distribution) and consumer preferences towards healthy food.

Regarding the food habits, they are undergoing profound changes due to the economic and social transformations. Casini et al. (2015) investigated the evolution of the food patterns in the past decade, in order to interpret them in light of demographic characteristics and sociocultural changes. By applying latent class clustering analysis to the food spending, of a sample of consumers in Italy, they tried to identify the principal food patterns. In particularly, they examined the variables that were associated with the pattern of the so-called "healthier" consumers, who are consumers with a dietary mix in line with the recommendations of health authorities (i.e., consumers that buy fruits, vegetables and fish). This choice gains ground among consumers with higher level of education and among couples, but also among families with children.

Recognizing that the demand for food has been growing due to population increase, Ariani et al. (2021) carried out a survey to analyze current and eco-friendly household consumption. For the synthesis of their technical review, secondary data were collected from Statistics Indonesia. Information about household food waste were taken from a previous survey by Indonesia Agency for Food Security. According to their findings, driving factors of household food choices were based on social, economic, and cultural aspects rather than environmental consideration. About the economic variables, results suggested that the higher the income, the better the quantity and quality of the food consumed. Regarding the food waste produced by each household, it came up that the larger proportion came from vegetables and fruits.

In their survey, Esteve-Llorens et al. (2021) examined the food consumption pattern at household level. They attempted to identify both the impacts that foodstuffs included in the food basket cause to the environment, and the socio-economic variables that influence the consumer choice. Data for household food consumption were collected from the Spanish Ministry of Agriculture Fishing and Food, whereas the sample examined was about 12,000 households, randomly selected. The results indicated a decrease of the carbon footprint over the years. However, this decrease is not always synonym with a healthier diet for the consumers. In addition, it is observed an increase in the consumption of processed foodstuffs and ready meals, which further distances the dietary pattern from the traditional recommendations. In the same spirit a corresponding survey performed by Esteve-Llorens et al. (2021), attempted to explore variations in food consumption patterns in terms of greenhouse gas emissions and nutritional intake adequacy for different climatic zones in Spain. Similarly, data for household food consumption were collected from the Spanish Ministry of Agriculture Fishing and Food and examined the same sample with the previous paper. According to the results, daily food basket and eating habits associated with different territories (climatic zones) were justified on the basis of different culinary culture and tradition, economic level and socio- demographic profiles. The higher carbon footprint recorded in some regions was due to higher consumption of animal origin products. On the other hand, consumption of higher amount of fruits, seafood and legumes provided some regions (northern region of Spain) a better nutritional profile.

The production of meat is pointed out as a significant source of greenhouse gas emissions. A transition toward plant-based and low-meat diets has been proposed as a pathway to mitigation of climate change. In this framework, Austgulen et al. (2018) investigated whether Norwegian consumers are willing and able to change their food choices, in a more climate-friendly direction, and what factors influence their perceptions for environmental measures related to food and meat consumption. They applied a consumer survey among 1,532 participants. The results indicate that consumers have limited knowledge about environmental impacts of meat consumption and are unaware of its negative climate impacts. It is also highlighted that most consumers are still not ready to consume food based on what is best for the climate or environment, such as eating less meat and increasing vegetables purchases.

Various consumer groups have been examined about their willingness to adopt environmentally friendly food consumption patterns. Among them it has been evaluated the role of London's community gardens in promoting participants' environmentally friendly food choices and habits, aiming to mitigate their footprint (Kim, 2017). The survey included: i) semi-structured interviews with community garden participants, and ii) an online questionnaire survey among 48 community gardens. The findings show that the majority of gardeners surveyed tend to have lower footprints than general people. However, they still have some carbon intensive food consumption habits, such as consuming meat regularly and shopping in supermarkets.

Emotions have a crucial role in mentoring consumers toward pro-environmental food consumption as well. Onwezen (2015) examined the function of emotions in purchasing choices for pro-environmental food. The survey was performed through questionnaires that were filled out by Dutch respondents, whereas the statistical analysis was based on Regression analysis. Their survey concluded that both private and collective emotions can mentor decisions towards environmentally friendly food choices.

Avetisyan et al. (2014) tried to assess Greenhouse Gas Emissions (GHG) associated with consumption of domestic and imported food products, and tradeoff between production and transport emissions, as well. Based on secondary data they conclude that encouraging consumption to local food products reduces global GHG emissions only when implemented in regions with relatively low emissions intensities.

Consumer preferences for agricultural products considering the value of biodiversity

The protection of biodiversity has gained popularity both in consumer opinion and in scientific debate. Credence attributes seem to play an important role in consumer preference formation especially for agricultural products. To analyze the effects of biodiversity on consumer purchase decisions some studies were conducted. Although there are few studies related to nature and biodiversity conservation in the literature, most of them suggest that consumers are sensitive towards the maintenance of the balance between biodiversity conservation and agricultural production. In particularly, the applied studies used mainly the stated preferences methods (i.e., Choice Experiment, Contingent Valuation Method) to assess consumers' preferences for buying foods produced with techniques consistent with environmental stewardship.

Most published research findings indicate a significant increase of consumers' concerns regarding the environmental impact of food production. In particularly, Moon et al. (2002) carried out a contingent valuation approach to measure a behavioral intention towards purchasing agricultural commodities produced by environmentally sound practices and protect wilderness. The study showed that the majority of participants were willing to pay a higher premium for products cultivated respecting biodiversity conservation practices.

Yabe et al. (2013) applied a choice experiment technique to analyze consumer preferences related to "life brand" products that improve biodiversity. They revealed that consumers' willingness to pay for these products increased as their awareness of biodiversity conservation increased. However, they placed greater importance on their health than on environmental conservation. Khai and Yabe (2015) tried to investigate the effects of biodiversity awareness on consumers' preferences for environmentally certified rice. By applying, similarly, the choice experiment method, they found that consumers were willing to pay a premium for one kilogram of environmentally certified rice to increase crane numbers and the biodiversity level in their area, as well.

The Choice Experiment applied also by Mazzocchi et al. (2019) to estimate wine consumers' willingness to pay for biodiversity conservation practices in vineyards. Their results revealed that consumers were willing to pay a premium price for wine certification that takes into account biodiversity (Mazzocchi et al., 2019).

5.2 Consumption Habits Towards Healthy Food and Expectations of Well-Being

The attitude of the modern consumers is influenced by the rising incidence of lifestyle diseases, such as heart disorders. The trend for healthier diet has generated an increasing competition on healthy food products within the food market industries. Without access to healthy foods, a nutritious diet is out of reach. For this reason, numerous surveys have been carried out to investigate public attitudes towards healthy food consumption.

In this spirit, a survey of 136 lecturers in Malaysia found that health consciousness strongly motivates consumers to purchase organic food (Mohamad Salleh et al., 2010). For the analysis of its results reliability test, correlation and regression analysis were applied. In particular, various statistical approaches were conducted, such as descriptive statistics and Cronbach's apha to ensure the consistency or stability of items. Factor analysis was used for the independent variables of environmental concern and health consciousness and Regression analysis for the prediction of purchase intention on organic foods. The findings show that health consciousness factors have more impact on customer purchase intention of organic food products, rather than the environmental concern.

There are publications examined demographic and personal value variables that seems to influence individuals' choices for health food. Dean et al. (2007) utilized results from 2,094 questionnaires from four countries (UK, Italy, Finland, Germany) to investigate public perceptions related to different healthy grain foods (bread, pasta and biscuits) and examine how these perceptions are influenced by gender, nationality, type of health claim (general vs. specific) and interviewees' perceptions about different production methods, as well. They performed T-tests to explore the differences between genders and countries on processing methods. ANOVA was performed to investigate differences between genders, countries, grain products and health claims on perceived benefits. Results confirmed that women perceived more benefit in products with general health claims and men in products with specific health claims. Additionally, modification of staple foods was regarded as more beneficial than fun foods, whereas people preferred processes such as traditional crossbreeding to others such as genetic modification.

Kraus (2015) tried to examine the motives by which consumers are guided when purchasing functional food. They performed a questionnaire survey among 200 respondents in Poland to determine the most important attributes of functional food products attributed by consumers. For this purpose, the results analyzed through statistics which included descriptive statistics and student's T-test for a single sample. Student's T-test was used for verification of each attribute included in the questionnaire. Among quality attributes highly evaluated by consumers are safe food, natural product and healthy product. Consumers considered also significant the attributes of packaging and labelling to include information on the healthful properties of the product. Finally, the most important healthful properties associated with the attributes are those that: a) mitigate the risk of cardiovascular diseases; b) strengthen the immune system; c) help maintain the correct body weight; d) mitigate the risk of certain cancers; e) strengthen memory; and f) improve physical condition.

For evaluating the effect of dietary preferences and food consumption on climate change and for quantifying their cumulative environmental impact, Churak et al. (2021) analyzed specific food consumption patterns and calculated the amounts of popular food consumed in Thailand. Their survey based on secondary data has been subtracted from The National Bureau of Agricultural Commodity and Food Standards, and primary data collected from 24-hour dietary recall for 18,746 participants of this survey. Results revealed that the highest accumulated greenhouse gas emissions were identified in the group of overweight participants. This group related to more animal-based foods consumption, as well.

Acknowledging the role of parental contribution to adopt environmentally friendly food choices by children, Halicka et al. (2021) attempted to assess the impact of sustainability issues on the behaviors of parents living with young school aged children in Poland. They performed a questionnaire survey among 1,035 adults. The results analyzed via a K-means clustering procedure to group respondents into consumer segments. ANOVA and Pearson's Chi-square independence tests were used to examine the differences between the examined clusters. The results revealed that parents appeared well intentioned in their motives for selecting food for their children, and they were engaged in raising their children's awareness on healthier and more environmentally friendly food consumption. As also emerged, it is commonly believed that family members should have a responsibility in teaching children for the links among food, health and environment.

The contribution of eco-labeling to healthier and more environmentally friendly food choices

The purpose of eco-labels is redirecting consumption to more environmentally friendly food choices. They have been recognized as a means of promoting products with lower environmental impact. A considerable body of literature has focused on consumer demand for eco-labels. Some of selected surveys are listed below.

There is a significant number of surveys focus on the effect of labels on the consumer choice to purchase environmentally friendly foods. In this framework, Slapø and Karevold (2019) test different traffic-light labels to investigate their influence on consumer selection for environmentally friendly dishes. In their experimental study apart from the labels, they placed auxiliary posters to explain the labeling systems and inform about the climate impact of various food categories. The total number of observations they received was 228. The Ordinary Least Squares Regression was applied to analyze the impact of the labeling system on sales of different dishes. The results support a significant reduction on sales of meat dishes, due to the information provided. However, the sales share of vegetarian dishes and fish were not influenced. Similarly, the presence of packaged food labels which carry nutritional information attracted research interest. According to Kozup et al. (2003), consumers have a more positive attitude toward products with detailed label descriptions and health claims.

There are also surveys that focus on the effect of eco-labels on income distribution and income inequality of producers. Chang (2012) performed a corresponding questionnaire survey focused on producers. For the analysis of its results the probit model was used. As noted from the findings, the use of eco-label in food products increases producers' income.

In terms of the contribution of media and advertising to promote food consumption and influence consumers perceptions or behaviors regarding healthier and more environmentally friendly food, research shows that individuals gain much of their health information from the media (Kean et al.,

2012). In addition, healthy eating habits were positively associated with watching television news and having higher levels of media literacy (Kean et al., 2012).

5.3 Policy and Practical Recommendations to Enhance Healthier and More Environmentally Friendly Food Choices

Most of the examined publications concluded to some practical or policy recommendations to redirect consumption to more environmentally friendly food choices. The main recommendations are divided into policy and practical ones and are presented below.

Policy recommendations

1. Design effective nutrition promotion strategies to encourage healthy eating in adolescence and targeting food supply and availability (Rathi et al., 2017).
2. Principles of healthy diets and sustainable food consumption should be included into public health programmes to raise children's awareness toward healthier and more environmentallyfriendly food consumption practices (Halicka et al., 2021).
3. Policy makers together with nutritionists and agronomists should develop a food system which balances productivity, sustainability, and community' nutrition fulfillment to reinforce environmentally friendly food consumption behavior (Ariani et al., 2021).
4. Efficient information provision to consumers should be part of environmental policy design, asfindings from different countries highlighted that most consumers are still not ready to make food choices based on what is best for the environment (Austgulen et al., 2018).
5. Increasing tax on less environmentally friendly food products could be a way to promote organic products (Taghikhah et al., 2020).

Practical recommendations

1. Agencies should strive and work in raising awareness about the benefits of healthy food consumption, through advertisements on social media, exhibitions that can share related information etc. (Sulaiman et al., 2017).
2. Eco-labeling may partially improve the eco-friendliness of food consumption (Slapø and Karevold, 2019). So, some additional actions and efforts should be designed in the direction of their greater utilization.
3. Encouraging consumers to adopt plant-based and low-meat diets may be an important contribution to mitigate climate change (Austgulen et al. 2018).
4. Emotions can be used in campaigns that focus on intentions towards buying organic food (Onwezen 2015).
5. Parental responsibility is a crucial issue, so parents should be encouraged to reinforce awareness of children on food, health and environment (Halicka et al., 2021).

In conclusion, a pathway towards sustainable food systems is consumer demand for healthier food and the persistence in environmentally friendly food selection. Increasing consumers' demand for

organics augment the rate of organic farming implementation and decrease the level of farmers' risk. From the farmers' point of view, it is important to receive information on consumer demand for organics to support farming decisions. Consumers' attitude is the most important predictor of intention to buy organic food.

Most of the publications examined indicate a significant increase of consumers' concerns regarding the environmental impact of food production. Consumers seem to care for the environmental and biodiversity protection. Attitudes and influence purchase intention and actual buying organic food include health consciousness, environmental consciousness, trend for healthier diet, subjective norm, socioeconomic and educational factors, demographic characteristics and price consciousness. Eco-labels can contribute significantly to redirect consumption to more environmentally friendly food choices, whereas advertisements on social media enhance the eco-friendliness of food consumption.

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6. Value Chain Modelling Tools

6.1 The Guidelines on Value Chain Modelling Tools

Various guidelines (also known as manuals or handbooks) exist for carrying out value chain analysis. Nang'ole EM, et al (2011) have investigated value chain manuals, value chain guidelines and value chain handbooks. Their study starts by reviewing the commonalities and differences in the definition of value chain and other relevant terms. Four stages of value chain analysis are described: appraisal, design, implementation and monitoring and evaluation.

J. Donovan, etal (2015) has reviewed 11 Guidelines for value chain development. They have reviewed the current guidelines on the base of VC objectives & motivations, VC definitions, Methodological design of VC, Data collection and analysis, Assessing & Monitoring outcomes and impacts.

P.M., Clay and R., Feeney (2019) have done a literature review on analyzing agribusiness value chains. Their study is devoted to two parts. The first part of the analysis delves into the value chain concept, with the aim of discovering how the concept has changed from an historical perspective, and what would be an acceptable narrow definition. The second and main part of the analysis seeks to study the methodological techniques for approaching and accurately analyzing a value chain in the agribusiness sector.

In recent years, governments, donors and NGOs have increasingly intention the value chain development for stimulating economic growth and combating rural poverty. For this reason, there has been an increase on "Guidelines development". In this section, fourteen well-known and widely used guidelines have been reviewed on their concepts and methods tested, tools used and endorsed with their case study projects. All investigated guidelines have been reviewed on the base of tools used which means the area of VC analysis and the produced outcomes in each related tool.

In Table 6.1, the guidelines are given with their concentrated subjects, survey instruments used, and types of approaches 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. The review process is based on the guides themselves-it does not present information from other sources of information- and based on the data which they are exactly tested and approved by the case study results. The most of the guidelines have used activity-based or agent-based or both for their value chain analysis. The guidelines included here which are activity based VC analysis base on all related main and supportive activities in the VC from the first step to end market such as Input provision, cultivation, collection, production, marketing and distrubiton and cunsumption.

Agent based value chain analysis base on the individual or institutional actors dealing with the activities done in the along the VC such as farmers, collectors, processors, wholesaler, retailer and consumers.

Table 6.1 Current Guidelines on Value Chain Analysis

The Guidelines	Concentrated subject	Survey Instrument	Approach Used	
			Activity Based	Agent Based
1.ILO-Value Chain Developmentfor Decent Work (2021)[1]	Working conditions, social welfare and legal protectionof employees throughout a VC	Conducting individual surveywith agents, and collecting ofsecondary data on legislation and practices		
2.VCA4D: Value Chain Analysisfor Development (2018)[2]	Economic, Social and Environmental Analysis	Secondary data analysis, focus group meeting, interview with stakeholders, software needs		
3.ACIAR- Australian Center for International Agricultural Research (2016)[3]	A guide to VC analysis and development for overseas development assistance projects	Workshops and focus groupmeeting, desktop studies, consumer research, gender analysis		
4.GTZ/GIS-Guidelines For Value Chain Selection (2015)[4]	Economic, environmental,social and institutional	Secondary data analysis, key informants' interview		
5.FAO- Developing sustainablefood value chains (2014)[5]	Economic, social and environmental impact of VC	Secondary data analysis, questionnaire-based survey with stakeholders, software needs		
6.FAO VC Analysis for Policy Making (2013)[6]	Quantitative approach forthe policy impact assessment	Secondary data analysis, statistical databases, Focusgroup discussion, semi- structured interviews and questionnaire		
7.UNIDO- United Nations Industrial Development Organization (2011)[7]	Pro-poor value chain development-Functionaland Social VC	Secondary data analysis,stakeholder interview		
8.IIED - International Institutefor Environment and Development (2008)[8]	A guide to multi- stakeholder process forlinking small-scale producers to modernmarkets	Participatory process, stakeholder workshops		
9.M4P: Making VCs Work Betterfor the Poor (2008)[9]	Poverty reduction-Impactof VC for the poor	Key informant interview,secondary data analysis		
10.USAID – United StateAgency Internatinal Development (2008)[10]	End market research toolkitupgrading VC competitiveness with informed choice	Secondary data analysis, focusgroup meeting, consumer survey		
11.GFU-Promoting ValueChains of Neglected and Underutilized Species (2008)[11]	Try to promote neglected & underutilized species' VCs	Rapid appraisal, key informant interview, in depth surveys, desk survey		
12.CIAT - Centro Internacional de Agricultura Tropical (2007)[12]	Participatory market chain analysis for smallholderproducers	Secondary data analysis, key informants' interview, focusgroup discussion		
13.FAO - Rapid Appraisals (2007)[13]	Guidelines for rapid appraisals of agrifood chain performance in developingcountries	Key informants' interview, structured direct observations		
14.CIP-International Potato Center(2006)[14]	Participatory market chain-Qualitative approach	Rapid market appraisal, focus group and quantitative marketstudy		

Sources:**1)**ILO(2021). Value Chain Development fro Decent Work. A systems approach to creating more and better jobs. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---ifp_seed/documents/publications/wcms_434362.pdf **2)**)European Commission(2018). Value Chain Analysis for Development (VCA4D), Methodological Brief. Frame and Tools, key features of experts' work. Version 1.2. Retrived from https://europe.eu/capacity4dev/value-chain-analysis-for-development-vca4d-/documents/methodological-brief-v12. **3)** Collins R.C., Dent B. and Bonney L.B. (2016). A Guide to value-chain analysis and development for overseas development assistance projects. Australian Centre for International Agricultural Research:Canberra, ACT. **4)** Schneemann, J. & Vredeveld, T. (2016). Guidelines for Value Chain Selection: Integrating economic, environmental, social and institutional criteria. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn, Germany. **5)** FAO. (2014). Developing sustainable food value chains – Guiding principles. Rome. **6)** Bellu, LorenzoGiovanni (2013), Value Chain Analysis for Policy Making, Methodological Guidelines and country cases for a Quantitative Approach, FAO, Rome, Italy. **7)** UNIDO (2011). Pro- poor Value Chain Development: 25 guiding questions for designing and implementing agroindustry projects. United Nations Industrial Development Organization (UNIDO). Vienna, Austria. **8)** Vermeulen, S., Woodhill, J., Proctor, F.J. and Delnoye, R. (2008). Chain-wide learning for inclusive agrifood market development: a guide to multi-stakeholder processes for linking small-scale producers with modern markets. International Institute for Environment and Development, London, UK, and Wageningen University and Research Centre, Wageningen, the Netherlands. **9)** Anonymous, (2008) M4P- Making Value Chains Work Better for the Poor: A Toolbook for Practitioners of Value Chain Analysis, Version 3. Making Markets Work Better for the Poor (M4P) Project, UK. Department for International Development (DFID). Agricultural Development international: Phnom Penh, Cambodia. **10)** Henning, R., Donahue, N., &Brand, M. (2008). End market research toolkit: upgrading value chain competitiveness with informed choice. Washington DC: USAID_AMAP-BDS. **11)** Will, M., (2008). Promoting Value Chains of Neglected and Underutilized Species for Pro-poor Growth and Biodiversty Conservation, Guidelines and Good Practices. Global Facilitation Unit for Underutilized Species, Rome, Italy **12)** Mark Lundy, María Verónica Gottret, Carlos Ostertag, Rupert Best, and Shaun Ferris (2007). Participatory Market Chain Analysis for Smallholder Producers, International Centre for Tropical Agriculture, Cali, Colombia. **13)** Silva, Carlos A., Filho, Hildo M de Souza (2007). Guidelines for rapid appraisals of agrifood chain performance in developing countries. Rome, FAO. **14)** Bernet, T., Thiele, G., & Zschocke, T. (2006). *Participatory market chain approach (PMCA)-user guide*. International Potato Center, Lima.

In Table 6.2, all the guidelines are investigated through the area of interest which concentrate on topics according to the analytical framework of the value chain analysis. The area of interest of the guidelines differs from one to another through the expectations and objectives of the BIOVALUE Project that are targeted.

Table 6.2 Guidelines with Their Area of Interests on Value Chain Analysis

The Guidelines	Institutional/ Functional Analysis	Economic/ Financial Analysis	Social Analysis	Environmental Analysis: Impact on Biodiversity
1.ILO-Value Chain Development for Decent Work (2021)				
2.VCA4D: Value Chain Analysis for Development (2018)				
3.ACIAR- Australian Center for International Agricultural Research (2016)				
4.GTZ/GIS-Guidelines For Value Chain Selection (2015)				
5.FAO- Developing sustainable food value chains (2014)				
6.FAO VC Analysis for Policy Making (2013)				
7.UNIDO- United Nations Industrial Development Organization (2011)				
8.IIED - International Institute for Environment and Development (2008)				
9.M4P -Making VCs Work Better for the Poor (2008)				
10.USAID – United State Agency International Development (2008)				
11.GFU-Promoting Value Chains of Neglected and Underutilized Species (2008)				
12.CIAT - Centro Internacional de Agricultura Tropical (2007)				
13.FAO – Rapid Appraisals (2007)				
14.CIP-International Potato Center (2006)				

Source: Authors' elaborations from guidelines reviewed.

6.1.1 ILO-Value Chain Development for Decent Work

Value Chain Development for Decent Work is a guide that takes a systems approach to value chain development with the goal of creating more and better jobs. The Guide is based on the International Labor Organization's (ILO) vast experience in using the systems approach for value chain development and focuses on decent work outcomes across the four pillars of the ILO Decent Work Agenda (Table 6.3).

Table 6.3 The Four Pillars of ILO Decent Work Agenda (with gender equality as a cross-cutting theme)

Job Creation	Rights at Work	Social Protection	Social Dialogue
Generating opportunities for investment, entrepreneurship, skillsdevelopment, jobcreation, and sustainable livelihoods	Recognizing and respecting the rights of allworkers, particularly disadvantaged or poor workers who need representation and laws that work for their interests	Promoting both inclusionand productivity by ensuring that women andmen enjoy working conditions that are safe, allow adequate free time and rest, take into account family and social values, provide for adequate compensation in case of lost or reduced income and permit access to adequate health care.	Involving strong and independent workers' and employers' organizations is central toincreasing productivity, avoiding disputes at work, and building cohesive societies.

Source: Authors' elaborations from ILO, 2021.

In this guide, Value chain analysis is realized in five steps:

Step 1: Map core value chain functioning

The Analysis begins with mapping the value chain to understand the flow of products or services from the raw materials through to final retail. Mapping involves identifying the processes, key market actors, value addition, different market channels relationships between actors, the number of target group members (e.g., women ormigrant workers), information about prices, and financial flows across the value chain. The data collected in this step is usually reported visually. There are many different ways to visualize a VC depending on the key actors, processes, and transactions, and their role in delivering a product or service, from raw materials to retail. Common topics and research questions to focus on during value chain mapping recommended by the Guide are firm-level performance, market linkages, power relationships, value chain governance, end markets, value addition, and capture as well as actors and processes in the value chain.

Step 2: Understand decent work deficits

This step is about identifying a set of decent work deficits. The identified decent work deficits are mapped onto the VC to show the hot spots. Starting with an open approach rather than a predetermined focus is advised to better study potential decent work deficits and their relevance and importance to the target group. The analysis can be built on the following common research topics: (1) Skills and employability, (2) Earning and income, (3) Job security and safety, (4) Health and well-being, and (5) Rights, respect, and cooperation (Table 6.4).

Table 6.4 Common Topics and Research Questions to Focus on During Decent Work Analysis

1-Skills and employability	A. How the structure of the workforce is shaped by market dynamics and regulatory issues B. How technology interacts with the workforce and impactssize, skills demand, wages, etc. C. How growth and the nature of market opportunities impacts firm decisions on the size and nature of the workforce D. How skills availability and gaps impact jobs outcomes
2-Earning and income	A. Are wages sufficient to meet basic needs? B. Are workers earning a fair orliving wage? C. Do wage structures provide adequate compensation for moving into higher productivity work? D. Are earnings allowing households to build wealth andprogress out of poverty? E. Do target groups receive non-wage benefits suchas housing, transport, meal and other allowances; and/or performance bonuses?
3-Job security and safety	A. Are people working under precarious conditions (including informally)? B.Do people face additional disadvantages due to their gender, ethnicity, or race? C. Do workers have regularized employment, predictable hours, and access tobenefits?
4-Health and well being	A. What levels of occupational health and safety currently exist? B. What are the trends in occupational accident and injury rates over time? C. How does worker health and well-being affect wider family and community well-being? D. Are gender-specific preventative measures in place? E. Are they issuesrelated to excessive stress in the workplace?
5-Rights, respect, and cooperation	A. Are employers respecting relevant labor standards, including minimum age for employment? B. Have there been reports of child or forced labor in the sector? C. Is there discrimination, harassment, and intimidation in the workplace? D. Are employment opportunities restricted on the basis of sex, gender identity, sexual orientation, political affiliation, skin color, ethnicity,or beliefs? E. Do workers have sufficient voice and the freedom to join representative organizations and bargain collectively?

Source: Authors' Elaborations from ILO, 2021.

Step 3: Identify important functions and rules

The purpose of this step is to go one step beyond the core value chain and identify the actors and factors surrounding the value chain (i.e., supporting functions and rules) that are "linked to a constraint facing the target group and one that could be feasibly addressed by the project". The identified damaging supporting functions and rules are mapped onto the value chain.

Step 4: Analyse constraints

After identifying problematic supporting functions and rules, the actors who set and enforce the rule or provide supporting action should be identified. This identification includes understanding the incentives andcapacities of each actor to change their actions associated with problematic supporting functions and rules. To conclude this step, a hypothesis should be formulated about the causes of the problematic supporting functions and rules, along with the incentives and capacities of each relevant actor.

Step 5: Develop a systemic change vision

The final step of the analysis phase is about developing a vision based on a set of prioritized systemic constraints to focus on in the action phase, considering the project's limited time, resources, and capacity. The vision to be developed should include an overview of the relevant market actors, the specific behaviors or practices that need to be introduced, and how these behaviors and practices can be embraced by the relevant actors. During this stage, the participation of stakeholders can be beneficial. The Guide recommends the Validation Workshop Method as a way to engage with the stakeholders to improve the quality of analysis.

6.1.2 VCA4D: Value Chain Analysis for Development

The purpose of Value Chain Analysis for Development (VCA4D) is **to provide decision makers with evidence-based information to feed sustainable development strategies**. It is directed to policy makers and stakeholders, and in this regard aligns with the EU aims as an aid provider and fits within its policy dialogue approach. Analyzing VCs sheds light on impact, uncovers main pathways, and identifies at which stages of the chain and for which actors, investment and support can generate benefits, eliminate drawbacks and constraints and foster sustainability and inclusiveness.

VCA4D measures key indicators that, when properly assessed and contextualized through expert discernment, provide fundamental information on a VC's impact and sustainability. This allows for the establishment of baselines and of an accurate description of the situation of actors. The ensuing image of the VC helps visualize practical operations, projects and policies and can be valuably used in the policy dialogue. The goal of a VCA4D study is to answer the following four Framing Questions (FQ) (Figure 6.1) using evidence-based elements, i.e., supported by quantitative indicators or explicit expert assessment (European Commission, 2018).

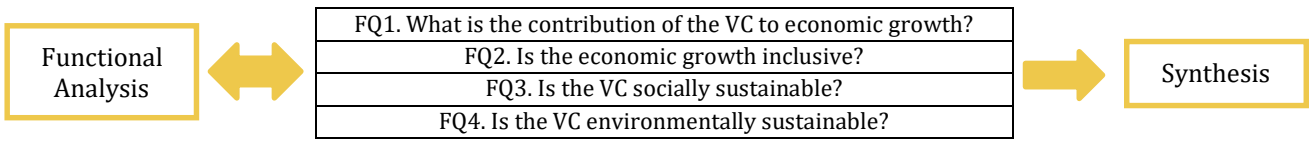


Figure 6.1 Overall Analytical Process (European Commission, 2018).

To answer these questions, VCA4D focuses on:

1. Providing quantified and evidence-based information, combining primary and secondary data collection, and
2. Making sense of it through an integrated multidisciplinary analysis by a team of international and national experts in economics, social affairs, and environment.

The analytical process is three-fold:

1. Implementing a functional analysis by setting out the overall VC operating features and inquiring about itsgeneral organisation and the main trends and market perspectives.

Functional analysis is both a starting point by which the team of experts arranges its work plan, and a continuous work of refinement throughout the study. It benefits to and from the other forms of analysis, allowing to build a common understanding.

It includes the definition of a typology of actors and the identification of sub-chains. Both are used by the whole team and must be relevant to outline the benefits and drawbacks for the various stakeholders at the various stages of the VC.

2. Performing economic, social and environmental analyses in order to respond to the four Framing Questions. These investigations are guided by a set of sub-questions, called Core Questions (CQ) (Table 6.5) Which:

- Point to required significant indicators
- Guide the assembly and processing of data (quantitative and qualitative)
- Give directions for interpreting the results, highlighting specific aspects of impact

The work process encompasses determining data needs and availability, carrying out collection of field information, processing and computing data, and direct interpretation of results.

The economic, social and environmental analyses are led in parallel by the relevant experts and share important elements, such as: the same typology of actors and sub- chains; parts of the data base, e.g., production levels, volume of flows, and technical coefficients (mainly economic and environmental experts). They also interact for specific investigations and analysis, e.g. on the VC governance, on marginalized groups,and on income and job distribution (mainly economic and social experts).

3. Making a Synthesis of the information produced which gives meaning to the many results, individual and combined.

Evidence-based indicators and qualitative assessments are reviewed and discussed among the team of experts. The way they relate to each other is examined, analyzing interactions and trade-offs. To appraise their significance, they may be compared to other available information (order of magnitude of other activities, benchmarking with other sectors or countries). They are analyzed in relation to the economic, societal and natural endowment context of the country, determining as much as possible how this context affects the VC results and how the VC operations impact on it.

Eventually, the synthesis combines:

1.Answering the four Framing Questions

2.Taking an integrated perspective on growth, inclusiveness and sustainability

3.Shedding light on risks, strengths and overall benefits

4.Recommendations

The goal is to enable decision makers' own judgement by informing them on each of the four framing questions. Deliberately, the VCA4D method does not aggregate all the knowledge elements into one single indicator. It is to be noted that although those studies are neither a project formulation nor a project evaluation process, the team of experts is expected to provide its views and recommendations, connecting their knowledge and the indicators within a comprehensive and systemic perspective on the VC.

Table 6.5 Framing and Core Question

FRAMING AND CORE QUESTIONS		
Economic Analysis	Social Analysis	Environmental Analysis
What is the contribution of theVC to economic growth?	Is the VC socially sustainable?	Is the VC environmentally sustainable?
CQ1.1. How **profitable and sustainable** are the VC activities for the actors involved? CQ1.2. What is the contributionof the VC to the **GDP**? CQ1.3. What is the contributionof the VC to the **agriculture sector GDP**? CQ1.4. What is the contributionof the VC to the **public finances**? CQ1.5. What is the contributionof the VC to the **balance of trade**? CQ1.6. Is the VC **viable in the international economy**?	CQ3.1. Are **working conditions** throughoutthe VC socially acceptable and sustainable? Do VC operations contribute to improving them? CQ3.2. Are the **land and water rights** implemented throughout the VC socially acceptable and sustainable? CQ3.3. Throughout the VC, do actors fosterand put into practice **gender equality**? CQ3.4. Do VC activities contribute to upgrading and securing the **food and nutrition conditions**? CQ3.5. Is **social capital** enhanced by VC operations and equitably distributed throughout the VC? CQ3.6. Do the VC activities contribute to improving the **living conditions** of the households through acceptable facilities andservices?	CQ4.1. What is the potential damage of the VC on resource depletion? CQ4.2. What is the potential damage of VC on ecosystem quality? CQ4.3. What is the potential damage of the VC on human health? CQ4.4. What is the potential impact of the VC on climate change? CQ4.5. Does the potential impactof the VC on biodiversity deservespecific studies?
Is the economic growth inclusive?		
CQ2.1. How is **income distributed** across actors of the VC? CQ2.2. What is the **impact of the governance systems on income distribution**? CQ2.3. How is **employment distributed** across the VC?		
Addressing the 4 Framing Questions		
Cross-cutting CQ. Which **risks** may affect the performance of the VC?		

Source: European Commission, 2018.

6.1.3 ACIAR- Australian Center for International Agricultural Research

The manual of ACIAR tries to promote 'value-chain thinking', which means taking a whole-of-chain perspective, emphasizing the importance of understanding markets and consumers, and collaboration among chain members. It highlights how effective partners can align their skills, resources and behavior to deliver products and services to receptive consumers and to reduce waste, with the resultant financial returns being distributed equitably so as to sustain the partnerships. It helps chain members to recognize their interdependence, and the consequent benefits of building collaborative relationships for solving the shared problems of creating and delivering consumer value (Collins R.C., et al (2016)).

This manual has been designed for a variety of users, primarily:

1. value-chain project developers and managers
2. researchers, trainers and extensions officers involved in projects, and undergraduate and postgraduate researchers who want to understand the principles and practice of value-chain thinking and analysis
3. value-chain members and any other project participants

4. stakeholders in development projects that incorporate value-chain analysis, such as leaders of in- government policy making and service delivery agencies, and of collaborating nongovernment organizations.

In the manual, the ways for the Value Chain Analysis were given with their specific objectives and completed with the case study results. Part 1 provides conceptual framework of Value Chain, begins with an explanation of the differences between "Supply chain" and "Value chain" and goes deeply in theoretical sides; Part 2 contains a detailed explanation of how to undertake VC projects for research, development and extension with the different parts explained. Part 3 contains some case study results, practical lessons from the field drawn from the ACIAR research projects in five different countries and Part 4 concentrates the training activities and their topics such as Mapping the VC, Market orientation, Mapping value, working as partners, Gender equity and others for the team members before starting the VCA.

6.1.4 GIZ/GTZ-Guidelines for VC Selection: Economic, Environmental, Social and Institutional

Guidelines for Value Chain Selection is based on practitioners working in value chain development, specifically with GIZ and the ILO. The document includes criteria and tools for value chain selection with the goal of generating the greatest impact in accordance with specific development objectives and project mandates through interventions to be designed within the project. It takes a holistic approach to the value chain selection process by integrating four dimensions as follows: 1) economic, 2) environmental, 3) social, and 4) institutional. These four dimensions are interrelated rather than being atomic components; economic, environmental and social factors are interwined and the institutional dimension is the enabling 'surrounding' environment (Figure 6.2).

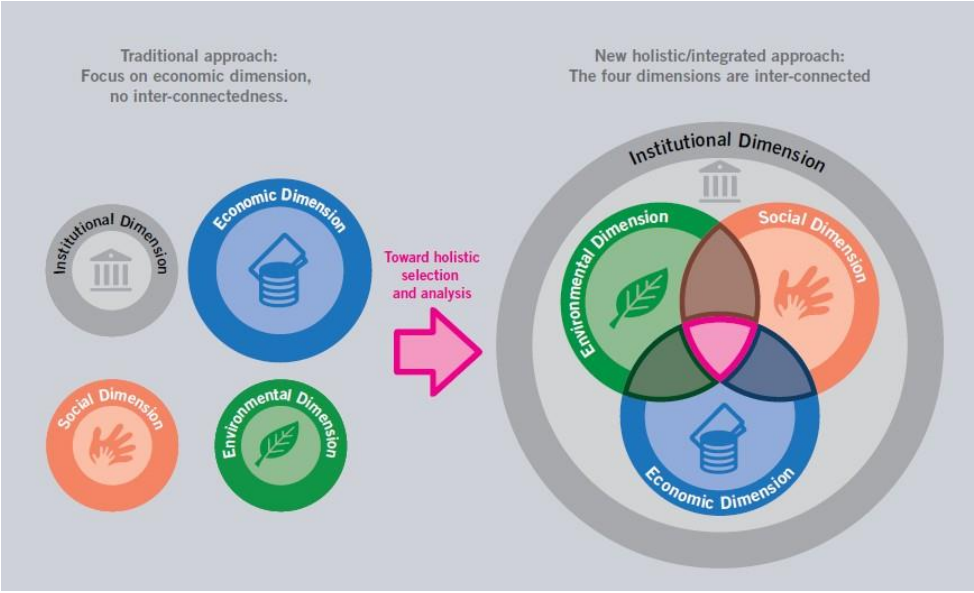


Figure 6.2 Four Dimensions of Value Chain Selection: Towards Holistic Selection and Analysis (GIS/GTZ, 2015).

As an initial step, it is important to describe the involvement of the stakeholders in the process by deciding which stakeholders you would like to involve, for what particular reason and at what time.

Eight steps in the value chain selection

The guidelines introduce the eight steps in the value chain selection process which guide practitioners to make a final decision for the value chain selection from a long list of potential chains. It is recommended to follow each step, whatever the order and the content might be tailored, according to the project targets and needs. The steps are as follows:

1. Preparatory phase

Step 1: starting point: scope and mandate of the program

Step 2: screening and shortlisting of promising value chains

Step 3: development of matrix with dimensions & criteria, optional weighing and scoring

2. Data collection phase

Step 4: desk study

Step 5: instruction of field staff and local consultants

Step 6: field investigation

3. Concluding phase

Step 7: workshop for validation and recommendations

Step 8: findings review, analysis and recommendations

Scoring and weighting the results might help arrive at a final choice in the value chain selection process however it might not fit into every context.

To be used during the value chain selection process, the Guidelines introduce a tool that is based on examining a set of key criteria to be considered for each of the four dimensions. The tool includes the indicators, guiding questions and useful sources of data for each criterion. Once again, scoring and weighting can be used for arriving at a final choice. A representation of the key criteria and respective suggested indicators is given in Figure 6.3.

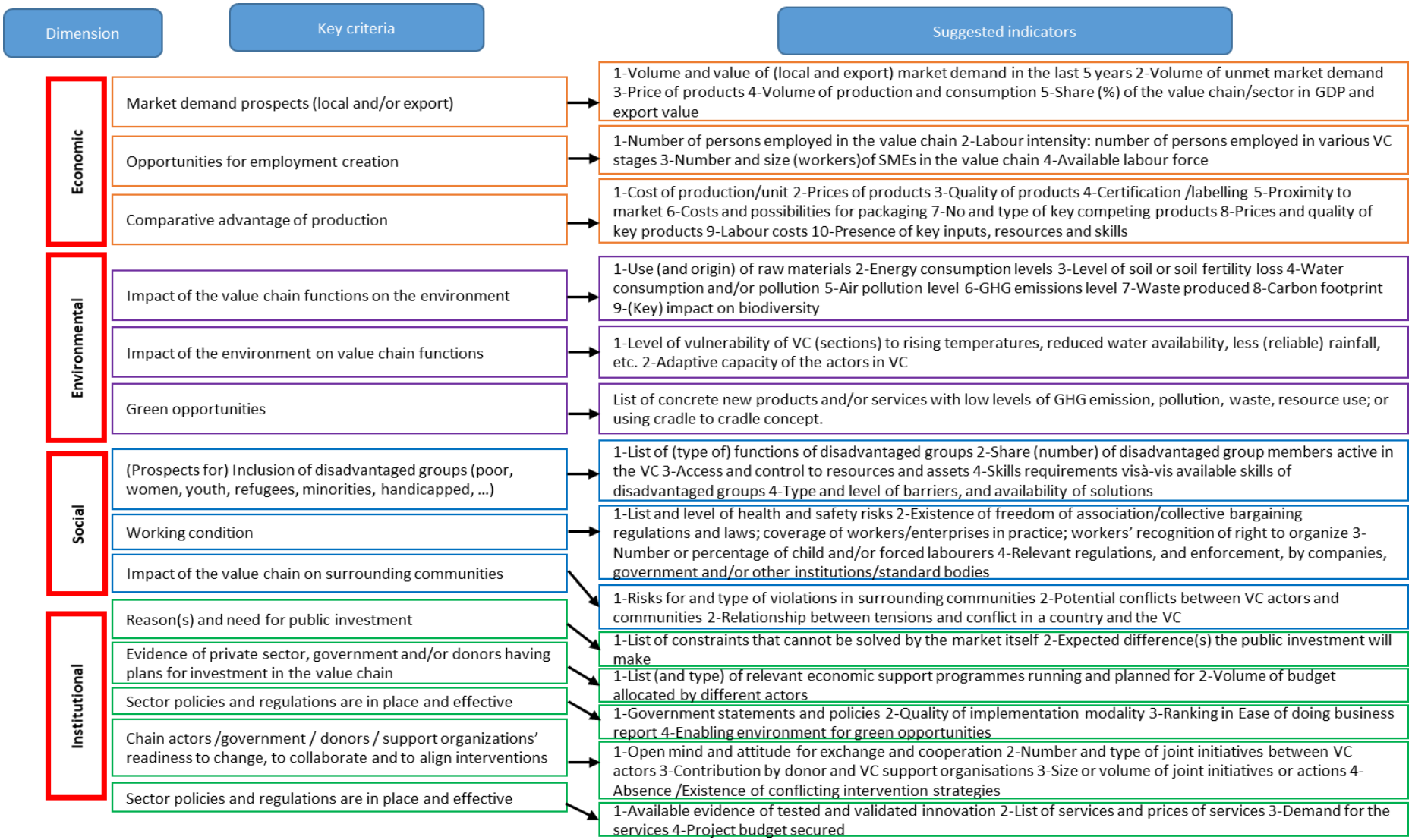


Figure 6.3 The Four Dimensions and The Respective Key Criteria and Suggested Indicators

Source: Authors' elaborations from GIS/GTZ, 2015.

6.1.5 FAO- Developing Sustainable Food Value Chains (SFVCs)

The SFVC concept recognizes that value chains are dynamic, market-driven systems in which vertical coordination (governance) is the central dimension and for which value added and sustainability are explicit, multidimensional performance measures, assessed at the aggregate level.

SFVC is a market-oriented and systems-based approach for measuring, analysing and improving the performance of food value chains

1. **General tools** examine the selection, mapping and sustainability elements of the analysis.
2. **Quantitative tools** look at the quantification of the value chain and the analysis of costs, revenues, profitmargins and value-added distribution along the chain.
3. **Qualitative tools** look at strategic factors, incentives and capacities, governance and market system analysis.

FAO's sustainable food value chain (SFVC) integrates two concepts that have become popular in developmentthinking and practice over the last decade: sustainability and value chains.

A *food value chain* (FVC) consists of all the stakeholders who participate in the coordinated production and value-adding activities that are needed to make food products.

A ***sustainable*** *food value chain* is 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)

In the SFVC framework value-added refers to the difference between the non-labor cost of producing food and the consumer's willingness to pay for it, adjusted for externalities.

The Concept of Value-Added

When talking about value chains, the chain part of the concept is relatively straightforward: the producer is linked to the aggregator, who is linked to the processor, who is linked to the distributor, who sells to the finalconsumer. The value part of the definition is perhaps less well understood. In the SFVC framework, value added refers to the difference between the non-labor cost of producing food and consumers' willingness to pay for the food, adjusted for externalities. This means that value added is best understood by looking at the ways in which it is captured by various stakeholders – as profits, wages, taxes, consumer surpluses and externalities (Figure 6.4). externalities can be positive or negative. For example, a food processor may pollute a river, which affects the income of fishers, or build a road to its plant, which benefits the rural communities living alongside it.

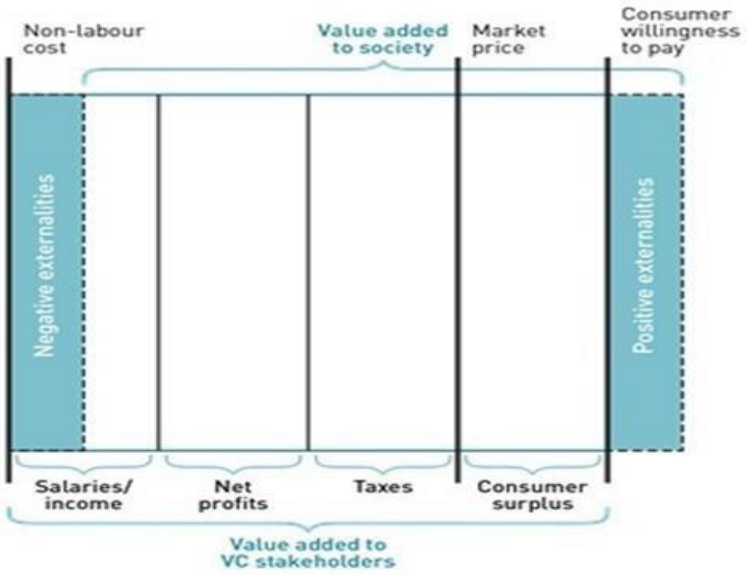


Figure 6.4 The Value-Added Concept in Food Value Chain Development (FAO, 2014)

The Concept of Sustainability

The SFVC framework is also explicit on the meaning of sustainability, to avoid giving rise to misunderstandings. In SFVC development, a holistic "triple bottom line" approach is applied, which recognizes three main dimensions of sustainability: economic, social and environmental (Figure 6.5). In the economic dimension, a value chain is considered sustainable if the activities carried out by each stakeholder are commercially viable, or fiscally viable for public services. In the social dimension, sustainability refers to socially and culturally acceptable outcomes in terms of the distribution of benefits and costs associated with the increased value creation. In the environmental dimension, sustainability is determined by the ability of value chain actors to generate positive of neutral impacts on the natural environment from their activities. By definition, sustainability is a dynamic concept in that it is cyclical and path-dependent: the sustainability of a value chain's performance in one period strongly influences its performance in the next one.

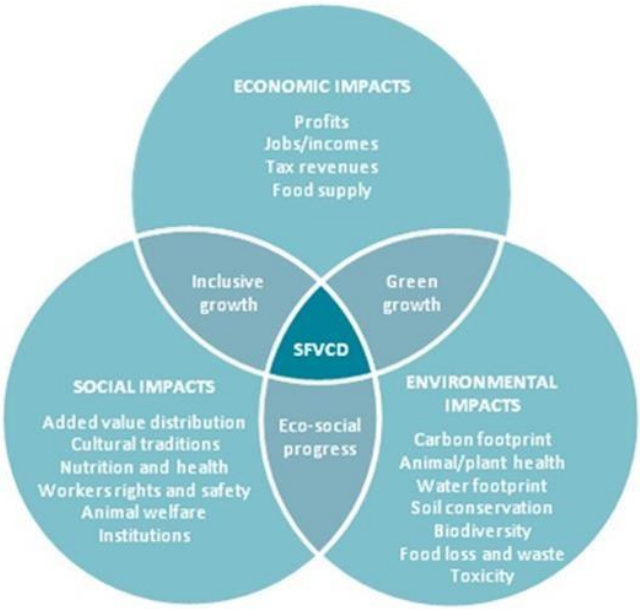


Figure 6.5 The Concept of Sustainability in Food Value Chain Development (FAO, 2014)

The SFVC development framework considers the FVC as the core of a system of complex economic, social andnatural environments that determine the behavior and performance of farms and other agrifood enterprises(Figure 6.6).

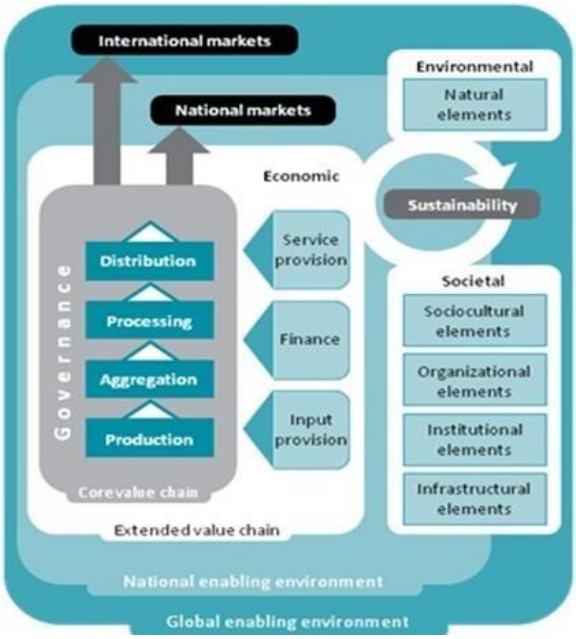


Figure 6.6 Sustainable Food Value Chain Framework (FAO, 2014).

Principles of sustainable food value chain development

SFVC development calls for a particular approach to analysing the situation, developing support strategies and plans, and assessing developmental impact. This is captured by ten interrelated principles (Figure 6.7). The approach is not about simply developing long lists of often well-known constraints and then recommending ways of tackling them one by one. Rather, SFVC development takes a holistic approach that identifies the interlinked root causes that explain why value chain actors do not take advantage of existing opportunities.

Figure 6.7 Principles of Sustainable Food Value Chain Development (FAO, 2014).

The ten principles are grouped into three phases of a continuous development cycle. In the first phase, *measuring performance*, the FVC is assessed in terms of the economic, social and environmental outcomes it delivers today relative to a vision of what it could deliver in the future (Principles 1, 2 and 3). SFVCdevelopment programs should target the value chains with the greatest gaps between actual and potential performance.

In the second phase, *understanding performance*, the core drivers of performance (or the root causes of underperformance) are exposed by taking three key aspects into account: i) how value chain stakeholders and their activities are linked to each other and to the economic, social and natural environment (Principle 4); ii) what drives the behavior of individual stakeholders in their business interactions (Principle 5); and iii) howvalue is determined in end markets (Principle 6).

The third phase, *improving performance*, follows a logical sequence of actions based on the analysis conducted in phase 2: developing a specific and realistic vision and an associated core FVC development strategy that stakeholders agree on (Principle 7); and selecting the upgrading activities and multilateral partnerships that support this strategy and that can realistically achieve the scale of impact envisioned (Principles 8, 9 and 10) (Table 6.6).

Table 6.6 General Overview of Developing Sustainable Food Value Chains

Dimensions	Tools	Suggested Indicators
General	1. End-Market analysis 2. Value Chain Mapping	1. Market type: High-end-market, niche market etc. 2. Differentiation of market segments 3. Size of markets, including volume and value 4. Ten-year forecasts and growth rates 5. Prices (over the year, across years, according to grades) 6. Consumer preferences, branding strategies, wholesale and retail distribution procurement systems 7. Drivers of the dynamics (including behaviour of lead actors, free trade agreements, regulations) 8. Identify critical success factors in these markets (e.g., price, quality, branding) 9. Primary Data (Key informant interviews/ Focused group discussion/Surveys/Field visits and observations) 10. Secondary Literature (National documents, data and strategies from ministries of agriculture, industry, trade etc)
Quantitative and Economic	1. Quantitative analysis 2. Value-added analysis 3. Production costs, profit margins 4. Productivity analysis 5. Pre- and post-harvest loss and waste factors 6. Benchmarking 7. Transaction cost analysis 8. Cost–benefit analysis	1. Cost structures and pricing 2. Calculating value addition and margins 3. Numbers of small-scale producers, and commercial farms 4. Cost factors of production 5. Outgoing costs (e.g., due to failure to allow for family labour costs/opportunity costs 6. Employee salaries, 7. Net profit for asset owners, 8. Taxes, 9. Consumer surplus, 10. Positive or negative externalities 11. Distribution of income 12. Variable and fixed costs 13. Factors of production, e.g., land, pastures, fodder/forage, labour 14. Productivity/ production capacity / costs structure/ growth rates/ investment 15. Information costs (identifying marketing options), negotiating costs, and monitoring and enforcement costs 16. Cost–benefit ratio of various production systems
Sustainability	1. Economic sustainability	1. Increased income, employment, taxes and food supply 2. Growth forecasts in the end-market 3. Entry into new markets and/or niche markets 4. Competitiveness of the value chain relative to rivals and possible substitutes 5. Successful branding of the product 6. Job creation
	2. Social sustainability	1. Inclusiveness of growth 2. Equitable distribution of benefits 3. Right to food, food security and nutrition 4. Empowerment of women, young people and disadvantaged groups 5. Resolution of potential conflicts, including land tenure issues 6. Promotion of workers' rights and occupational safety and health
	3. Environmental sustainability	1. Improved resources management (water, land, feed etc.). 2. Optimization of grazing by balancing and adapting grazing pressures on land (improved carbon sequestration and lower carbon emissions). 3. Improved waste management (e.g., storage and use of manure as an energy source).
Qualitative	1. Market System Analysis 2. Strategic Analysis	1. Identify leverage points such as organizational nodes (e.g., producer associations) 2. SWOT (it may include elements of the extended value chain and enabling environment (production, processing, marketing, policy) and/or consider thematic issues specific to the focus of the project (quality, nutrition, climate, gender and minorities, food safety).

Source: Authors' elaborations from FAO, 2014.

6.1.6 FAO-VC Analysis for Policy Making: Quantitative Approach for the Policy Impact Assessment

This guide is developed by the FAO which is focused especially on policy making through the quantitative approach. These guidelines provide users with the key notions required to carry out analyses of policy impacts by means of a value chain approach and show how to do it by making use of relevant approaches and tools. In particular, users will find this material useful to identify the main features of a given value chain, build consistent value chain accounting frameworks, building alternative scenarios reflecting changes that given policy measures are likely to introduce in value chains, measure in monetary terms shifts in physical production, value added, and income accruing to the various agent involved and provide relevant information to decision makers and other stakeholders involved in policy making processes. For instance, the user will be driven to identify the basic units operating in a given value chain and the activities they undertake, quantify revenue, value added and profits of every agent, build different scenarios for selected policy options, calculate value added and other margins, compute protection and competitiveness indicators. (Bellu, L.G.,2013).

VCA for policy making has to look at value chains from different, albeit correlated, perspectives. It allows analysts to identify issues (constraints, opportunities, strengths and weaknesses) to be addressed by policies. Analyses to be carried out cover the following domains (Bellu, L.G.,2013):

a) Socio-economic context of the value chain. This analytical domain identifies and outlines the key elements of the context, such as the geo-strategic, macro-economic and social situation of the country(ies) in which the value chain develops, explains how these elements influence the value chain and vice-versa.

b) Demand for value chain outputs. It is important to investigate the consumer side of a value chain. The current and potential demand of the various final output(s), their various destinations and related price trends have to be considered. This allows analysts to identify threats and opportunities related to the destination of the value chain outputs to be addressed by means of appropriate policies.

c) Analysis of the institutional set-up. The identification and appraisal of the institutional set-up, i.e., set of interactions taking place among agents and the formal and/or informal rules governing them is a key aspect when designing policies aimed at fixing issues related to the value chain governance.

d) Analysis of input and output markets. A specific focus on markets allows analysts to understand agents' behaviour and to further explore the institutions governing the value chain because there are close relationships among markets' set-up, rules and agents' choices. The degree of competitiveness, the existence of monopolies, monopsonies, oligopolies, market segmentation etc. strongly contribute to determine the value chain's performances. Policies have to be shaped considering the existing and desired market structure.

e) Functional analysis of the value chain. The functional analysis provides a detailed profile of the industry structure and production technology by identifying, describing and quantifying in physical terms the sequence of operations concerning commodity production, processing, marketing and final consumption and related agents carrying them out.

f) Economic analysis of the value chain. This analytical domain assesses in quantitative terms the value-added creation and distribution processes. The economic analysis allows analysts to determining for instance, the value added created by the overall value chain, the value added and margins for each economic agent at each stage of the chain, the value-added distribution among factors (capital: profits, labour: wages, other assets: rents). Pretty much as most Cost-Benefit Analyses (CBAs), the economic analysis of a value chain is carried out both from the perspective of private agents, using market prices, and from the perspective of the society as a whole, using the so-called "reference prices". These are figured out in the Figure 6.8.

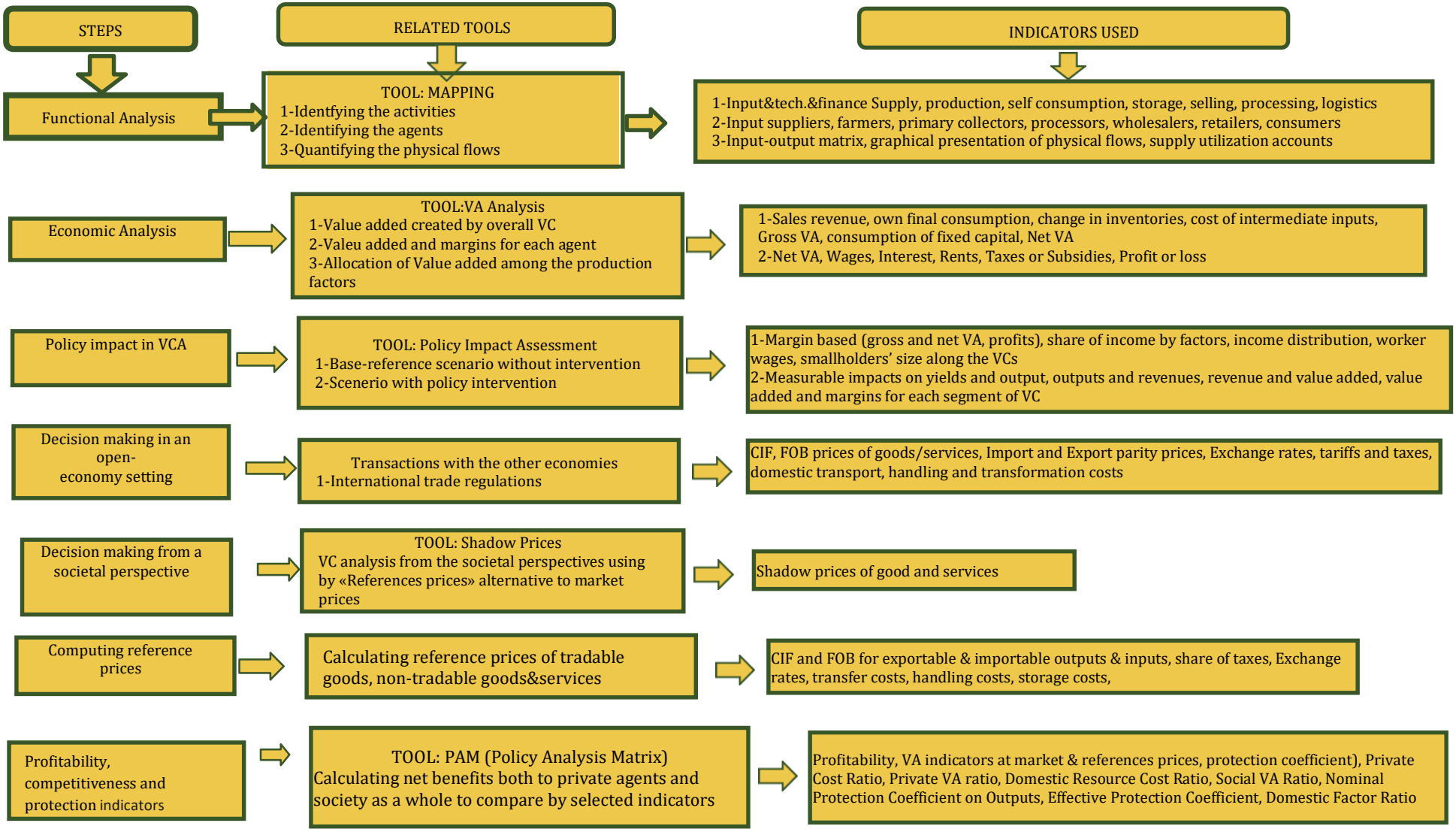


Figure 6.8 General Overview of FAO-VC Analysis for Policy Making: Quantitative Approach for the Policy Impact Assessment

(Authors' elaborations from FAO, 2013)

6.1.7 UNIDO-United Nations Industrial Development Organization

The guide builds on a review of common practices in value chain development projects in Asia and the Pacific region as well as on experience from six case studies of value chain development projects in Sri Lanka, Vietnam and Indonesia. The guide moreover draws from a consultation of experts in agricultural value chain development orchestrated by UNIDO in Vienna, September 2010, and was tested during an interactive training workshop with program managers from Asia in February 2011, in Kerala, India.

The 25 questions plus the many checklists, tools and lists of guiding questions have been developed on the basis of project analysis and design activities that the authors have engaged in during the last decade also making use of the many existing tools on the market. All tools have been tested and practiced in the field.

The questions focus on problems and complications that often occur during the different phases of value chain selection and analysis, and design and implementation of related projects. The guide does not attempt to provide theuser with all the information needed to develop a full-fledged Project implementation plan. Rather, it offers recommendations on project management and organization for the analysis and design phases of a project, complementing in-depth planning and formulation.

Following the steps of project cycle management, the manual is structured in five sections: (1) selection/validation of the value chain; (2) functional value chain analysis; (3) social value chain analysis; (4) project design; and (5) implementation. Each section provides five key questions that draw attention to good practices. Under each questionthere is information regarding: i) objectives, ii) the relevance of the question in practical situations, iii) important elements that need to be considered in answering the question, and iv) pitfalls that may occur when dealing with the question.

6.1.8 IIED-International Institute for Environment and Development: A Guide to Multi-Stakeholder Process for Linking Small-Scale Producers to Modern Market

This guide has been developed through a collaborative process involving many of the partners from within the Regoverning Markets consortium and outside.

This guide is prepared as part of the wider Regoverning Markets Program, Inclusion of Small-scale Producers in Dynamic Local and Regional Markets, funded by the UK Department for International Development (DFID), the International Development Research Centre (IDRC), the Canadian International Development Agency (CIDA), the Netherlands Interchurch Organization for Development Co-operation (ICCO), Cordaid, and the US Agency for International Development (USAID). The donors' support for this work has been much appreciated, in particular that of Susan Thompson of USAID, who gave specific encouragement for the development of this guide, as well as DFID and USAID, who provided supplementary funding. The input from Wageningen International into writing and publishing the guide was made possible through the International Policy Support Program of the Netherlands Ministry of Agriculture, Nature and Food Quality.

The manual has been developed through a collaborative process among many of the partners involved in the Regoverning Markets Program. The general concept was developed by project

partners from the International Institute for Environment and Development, Wageningen International University and Research Centre, the Natural Resources Institute and the International Food Policy Research Institute. This then led to further development and operationalization of the overall methodology and the specific tools in seven countries: Turkey, Indonesia, South Africa, Morocco, Bangladesh, Pakistan and the Philippines. In addition, a learning workshop involving participants from across Asia worked through the methodology using four different case studies and provided feedback on the draft manual. The final draft of the manual was then peer reviewed.

Broadly, this guide is for anyone interested in finding practical ways to enhance opportunities for small-scale producers in modern markets. Users may be market actors interested in creating direct links with small-scale suppliers, government policy makers tasked with rural development, producer organizations working for their members, NGOs working for the rural poor, or researchers working to understand and support processes aimed at greater inclusion of small-scale producers.

Mostly there will be some combination of these actors working together to develop opportunities and find innovative solutions to barriers. Specifically, the manual has been designed for those initiating, designing, managing or facilitating such a process. Those with responsibility for managing or understanding a process will find Chapters Two and Three most useful, while those who need to design and facilitate a process will find the tools to do this in Chapters Four, Five and Six.

Despite increasing value chain integration, different actors in agrifood markets do not get many opportunities to talk with each other about the big issues affecting the entire chain. Testing this methodology showed how different actors found it useful to come together and jointly work through the questions posed by the methodology.

The manual has been developed around four key concepts: 1) modern markets, 2) value chains, 3) institutions and policies, and 4) multi-stakeholder processes.

6.1.9 M4P-Making VCs Work Better for the Poor: Poverty Reduction-Impact of VC for the Poor

This guide provides value chain practitioners with an easy-to-use set of tools for value chain analysis, with a focus on poverty reduction. The aim of this guide is to strengthen the links between value chain analysis and development interventions that improve the opportunities available to the poor (Anonymous,2008).

The guide is designed as a concise manual to be used in the field and by those involved in project development and/or assessment of investment opportunities. The focus is on providing easy to follow tools and clear explanations about their use. This includes examples of how these can and have been used in real value chain analyses in the past. Although the value chain analysis theory that underpins the tools presented in the guide is an important element, the practical aspects of analysis dominate the guideline content (Anonymous,2008).

The guide is organised in two sections. The first section gives a theoretical background to value chains and also explains the pro-poor entry points for value chain analysis described in this guideline. The second section contains eight practical value chain analysis tools that can be used to analyse different dimensions within value chains. These are; ***Prioritising Value Chains for***

Analysis, Mapping of the Value Chains, Governance: Coordination, Regulation and Control, Standarts, Linkages, Relationship and Trust, Analysing Options for Demand Driven Upgrading: Knowledge, Skills, Technology and Support Services, Analysing Costs and Margins, Analysing Income Distribution, Analysing Employment Distribution (Anonymous,2008).

The eight tools are grouped in three sub-sets. The first sub-set contains two general tools on value chain selection and mapping of value chains. The second sub-set contains three qualitative tools to analyse the governance structure, linkages, and opportunities for upgrading. The third sub-set contains three quantitative tools to analyse costs and margins, income distribution and employment distribution. All these concepts of the M4P Guideline are elaborated by the flows in the figure given as follows (Figure 6.9).

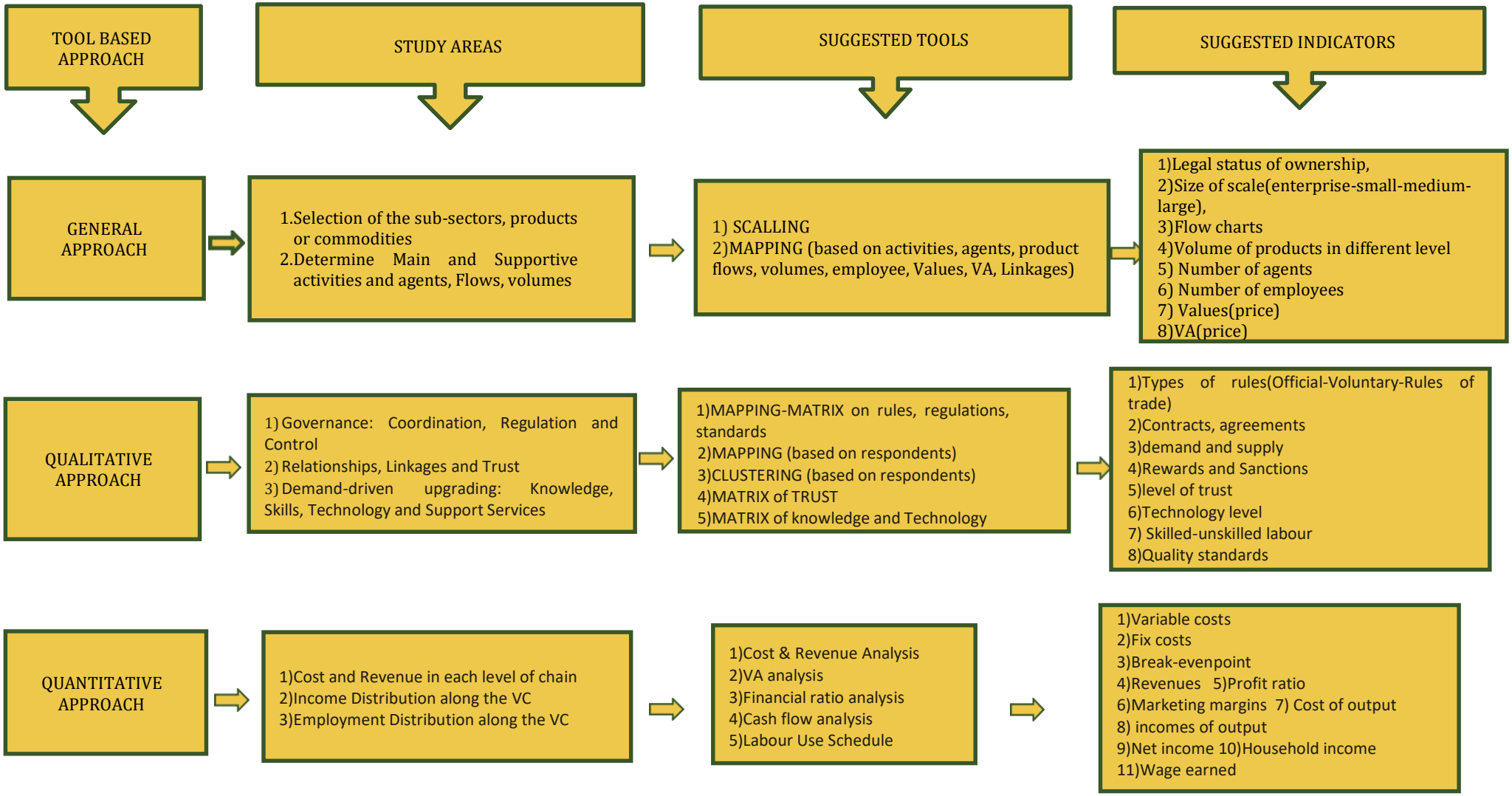


Figure 6.9 General Overview of M4P: Making VCs Work Better for the Poor: Poverty reduction-Impact of VC for the Poor

(Authors' elaborations from M4P, 2008)

6.1.10 USAID-United State Agency International Development: End Market Research Toolkit Upgrading Value Chain Competitiveness with Informed Choice

Structure of the Toolkit

To give practitioners a solid but manageable intellectual base to understand the different components of market research and their importance to the process, the toolkit is structured into two broad sections in line with common practices in market research

Phase I: Secondary End-market Research, and Phase II: Primary End-market Research.

The actual analysis to facilitate decision-making is structured around *Six Cs (Choice, Context, Channels, Customers, Competitors, and Communication.)* Linear progression through the *Two Phases* and *Six Cs* provides a clear roadmap for designing and implementing an effective and efficient End-market Research effort.

The success of private firms is only the beginning of successful Value Chain development. Successful Value Chain development involves the creation of a vibrant Value Chain where all stakeholders are focused on the needs of the market and create collaborative business models that promote equitable growth. Achieving this vision of broad-based economic growth is the ultimate goal of Value Chain development. End-market Research should be the first step in designing a competitiveness strategy that creates a roadmap for identifying and serving the best customers in the world for the products and services that developing country value chains are able to sell.

Before implementing an End-market Research effort, practitioners should keep the following guidelines in mind:

1. **Clearly define the decisions to be made with the research:** The End-market Research process should move backwards from a clear understanding of what business and investment decisions will be made with data. Once this is known, an efficient and pragmatic research agenda can be designed.

2. **Understand the CONTEXT and capabilities of the Value Chain:** Knowing and respecting the limitations of Value Chain clients on an operational level is a key element of designing a research plan that will yield actionable insights and a strategy that can be pursued given existing limitations of the industry.

3. **Channel partners are often the most relevant target for End-market Research:** Export-oriented value chains in developing economies are usually a few steps removed from the end consumer. What is critical in this case is to understand the requirements of the intermediaries and partners who purchase and distribute the industry's goods and services to the end-market.

4. **Strategy should begin with understanding CUSTOMER needs:** Serving and anticipating customer needs is the way to win in the global marketplace. The needs of these customers can be determined through perceptions of channel partners or direct research, especially in the case of domestic value chains.

5. **Competitors should be benchmarked to determine best practice and differentiation strategies:** Value chains do not compete in isolation, and customers always have choices about

where to purchase their goods and services. A component of End-market Research is to identify key competitors and decide whether the target Value Chain can compete directly with these competitors or needs to articulate and execute an alternative strategy.

6. **End market research is useless without clear COMMUNICATIONS throughout the process:** Too often, good research ends up gathering dust on a shelf. To avoid this fate, Value Chain stakeholders should be engaged from the beginning in the design of the research, reframing strategic discussions around data and actively participating in activities that bring them into direct contact with the market.

7. **Strategic CHOICES should be the outcome of a well-designed End-market Research effort:** To return to the first imperative, End-market Research is most valuable when it informs clearly defined business decisions that can build the competitiveness of the Value Chain. Research for the sake of information gathering is money poorly spent. Strategy can be defined as "Informed Choice and Timely Action."

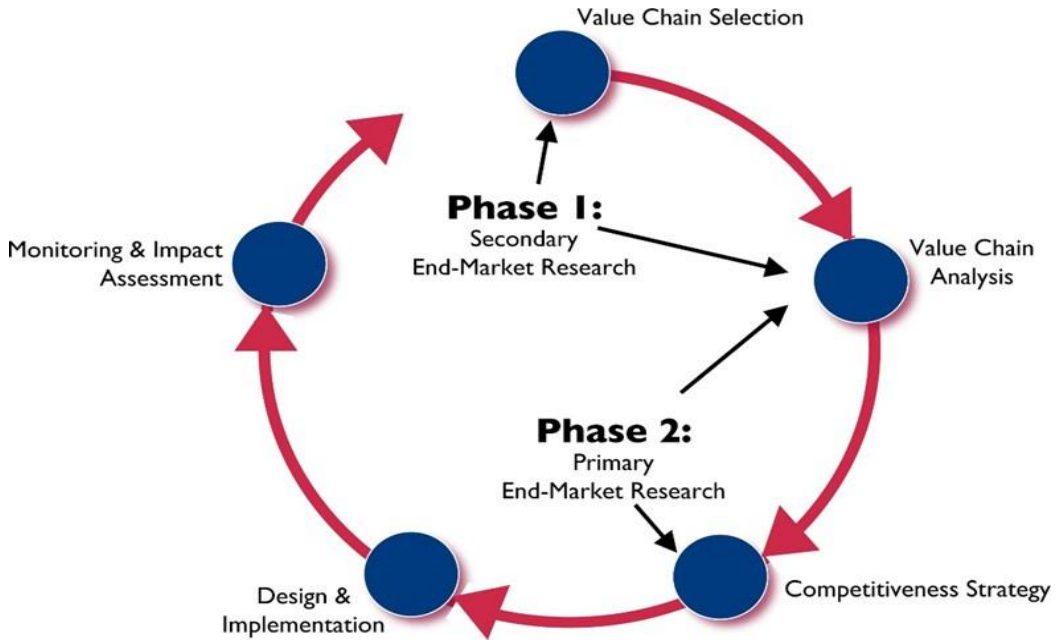


Figure 6.10 End-market Research within the Value Chain Development Cycle (Henning, R. Et al. 2008).

Within a larger Value Chain development project, End-market Research can be used during two different stages of the Value Chain Development Cycle (Figure 6.10). The Secondary End-market Research tools can beused during the Value Chain Selection stage to give the practitioner an idea whether or not a viable market exists for a variety of value chains. If this market exists, End-market Research can also indicate where the most attractive markets can be found for the products and services of the Value Chain. Once the most attractive markets have been identified, the full range of Primary End-market Research tools (surveys, in-depth interviews, focus groups & observation) should be used to define the needs of particular customer segments that the Value Chain would like to target.

6.1.11 GFU-Promoting Value Chains of Neglected and Underutilized Species

This guide presents stages and good practices for value chain development of neglected and underutilized species (NUS). The guidelines draw upon lessons learnt and good practices described in eight case studies from the different continents implemented by Global Facility Unit such as "African garden egg in Ghana", "African leafy vegetables in Kenya", "Amla, kokum and Tamarind in India", "Garcinia species in South India", "Minor millets in India", "Emmer in Turkey", "Farro in Italy" and "Maca in Peru" (Will, M.2008).

The guide begins by first giving a brief introduction to basic concepts for value chain development of neglectedand underutilized species, the impact of neglected and underutilized species in value chain development striving for social, economic and environmental impacts, drivers fostering and hampering the utilization of biodiversity.

This is followed by introduction of the strategic cycle for participatory value chain development. The fourth chapter takes stock of methodologies and tools for building structure and capacities for sustainable neglected and underutilized value chain development. Building on these guiding principles and possible approaches to NUS-VCD, the last two chapter look at the questions of how far and with what preconditions NUS-VCD can contribute to the main objectives of biodiversity conservation and pro-poor growth by discussing social, economic and environmental impacts and summarizing lessons learnt from case studies and other field of experiences.

The guideline is aiming at providing interested readers with more practice-oriented guidance than theoretical discourse, academic explanations has been kept shorter. For those interested in theories, every section is complemented by recommendations for further reading.

The GFU guideline consist of five different steps starting from a selection of the neglected and underutilized species and ending at the step of implement, monitor and refine the VC development strategy. The Guideline steps and each individual bundle of criteria that are under consideration given in followed figure. The criteria address the main topics that will be concentrated on each step along the VC analysis (Figure 6.11 and Figure 6.12).

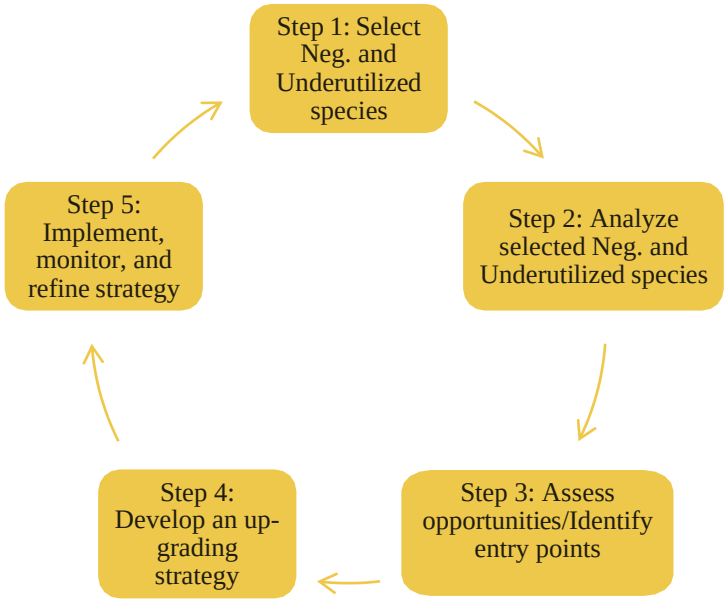


Figure 6.11 Five steps of VC analysis on Neglected and Underutilized Species (Will, M.,2008).

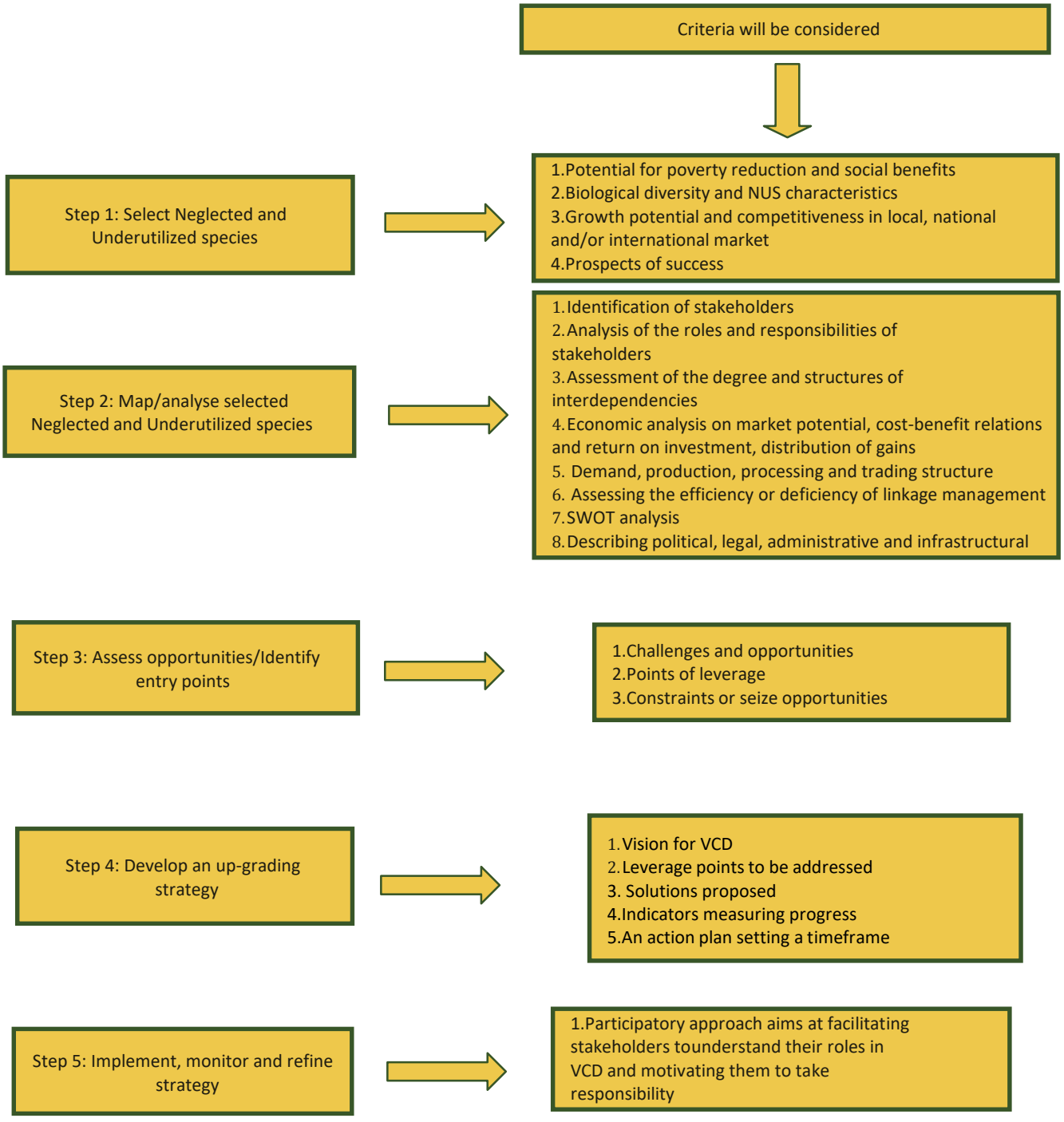


Figure 6.12 General Overview of GFU-Promoting Value Chains of Neglected and Underutilized Species (Authors' elaborations from Will, M., 2008).

6.1.12 CIAT-Centro International Agriculturel Development: Participatory Market Chain Analysis for Smallholder Producers

Among the first guides available for helping development practitioners work with smallholders and small businesses in formulating a VCD strategy was the Participatory Market Chain Analysis for Smallholder Producers. It presents a relatively simple and well-integrated conceptual framework and implementation is designed to be highly participatory.
Direct users: Providers of advisory services to smallholders and producer groups
Intended beneficiaries: Smallholders and businesses in a given subsector in a given territory
Provide a practitioner with a better understanding of a production chain and facilitate sufficient negotiationsbetween participants to lay the groundwork for the formation of a value chain.

Market Chain distinguishes between two types of chains:

1. a supply chain (SC) that connects all the actors involved in the movement of agricultural goods from the farm to the consumer; actors in a SC are assumed to have limited incentive to engage in more intensive coordination
2. a VC that is understood as a strategic network between a number of independent business organizations

VCD is the conversion of a supply chain into a value chain, the formation of which is expected to increase the competitiveness for chain stake- holders; it is assumed that increased competitiveness results in higher income for smallholders and small businesses that participate in the VC.

Key concepts applied

- Market chain
- Value chain
- Supply chain
- Synergies
- Chain support services
- Competitiveness strategy

Key methodological steps/components

- Select subsector/chain
- Rapid market survey
- Identification of key actors in market chains
- Participatory chain analysis
- Analysis of critical points in the chain
- Elaboration of chain development strategyOutputs from guide implementation
- Map of chain (actors, products, prices)
- Identification of bottlenecks in chain
- Identification of potential solutions
- Strategy to increase competitivenessMethods for data collection
- Key informant interviews with VC actors
- Review of secondary information
- Participatory chain mapping
- Participatory workshops with VC participantsMethods and tools for data analysis
- Provides details and examples on how to carry out analysis using participatory data collection and assessment tools (pairwise ranking, problem tree)
- Tables (with examples) are provided for organizing information
- Participatory workshops suggested for ranking of problems and opportunities

6.1.13 FAO-Rapid Appraisals: Guidelines for Rapid Appraisals of Agri-Food Chain Performance in Developing Countries

This guide presents a methodological strategy for the analysis of agrifood value chains. Simply stated, chains can be seen as sets of interrelated activities that are typically organized as sequences of stages. In the agricultural, food and fiber sector, chains encompass activities that take place at the farm level, including input supply, and continue during first handling, processing and distribution. As products progressively move through the successive stages, transactions between chain actors – producers, processors, retailers, etc. take place. Money changes hands, information is exchanged, and value is progressively added. Seen from a broader, systemic perspective, the chain concept includes also the 'rules of the game' – laws, regulations, policies and other institutional elements - as well as the support services, which form the environment where all activities take place. Value chain analysis under such a broad view seeks to characterize how chain activities are performed and to understand how value is created and shared among chain participants. It seeks also to evaluate the performance of chains and identify what, if any, are the barriers for their development.

One of the main motivations for preparing these guidelines was the need to promote a pragmatic approach to agrifood chain analysis. Based on a set of fundamental principles, it proposes a methodological strategy that can be readily followed by field practitioners interested in examining agrifood systems with the purpose of understanding their organization and functioning, and in identifying possible areas for performance improvement. More specifically, the guidelines aim to accomplish the following objectives:

- Provide information on the conceptual fundamentals of chain analyses, highlighting their importance in its planning and execution, as well as on the implementation of its recommendations
- Assist practitioners in the selection of the necessary information for the analysis, as well as on the methodsto obtain, organize and evaluate it
- Orient practitioners in the identification of problems affecting chain performance and of areas which could be seen as leverage points for further growth and development
- Propose a general approach towards the definition of chain interventions aiming at performance improvement, with the identification of stakeholder responsibilities for implementation
- Propose a general approach for the prioritization of chain interventions
- Point out the limitations and potential difficulties of conducting chain analyses

These specific objectives and the delimitation of the intended readership reflect the fact that these guidelinesare meant to cover only a subset of the many purposes and domains for which chain analysis is being applied.

The guidelines are organized in four sections. Following this introduction, the conceptual basis for value chain analysis is examined. The third section discusses and illustrates each step of the proposed methodology. The aspects of research organization, data collection, information analysis, performance assessment, intervention design, prioritization and results validation are covered. Concluding, general recommendations on the application of the methodology are presented.

6.1.14 CIP-International Potato Center: Participatory Market Chain-Qualitative Approach

The main objective of this guide is to present the Participatory Market Chain Approach (PMCA), which aims to stimulate market chain innovations by involving different stakeholders within a well-structured and demand-oriented process. By presenting both theory and practice, this guide should enable the leaders to apply the PMCA method in the specific context in which they are working.

This guide will help: Researchers and development staff to gain important insights and skills which will allow them to adapt and use PMCA in the context of their own work; R&D project managers and policy makers to understand, plan and supervise demand-oriented participatory R&D processes that target market chains; Teachers and students to learn more about rural development, market chain competitiveness, participatory R&D, and marketing. The different development concepts and practical tools described are helpful in their own right.

The guide includes the following chapters;

Chapter 1: Basic concepts of market chain competitiveness that influence rural development processes.

Chapter 2: The Participatory Market Chain Approach (PMCA) which describes a three-phase structure aiming to (1) define, (2) analyze and (3) put in place innovations in partnership with market chain actors.

Chapter 3: Useful tools which can be applied in conjunction with PMCA.

Chapter 4: First applications of PMCA, describing four initial experiences with PMCA in Peru, Bolivia and Uganda and drawing important conclusions in each case.

Chapter 5: Challenges when using PMCA, illustrating the problems R&D organizations might face when applying PMCA in their own context.

6.2 Other Types of Modelling Tools: Special Interest of Task Objectives

6.2.1 Production Process

As mentioned before, value chain can be defined in terms of market actors and activities in production and marketing of agricultural products and services. Therefore, the different terms used in the literature such as value chain, supply chain, market system, market chain, and agri-food chain (Donovan et al., 2013). As a set of activities, value chain describes the full range of value adding activities required to bring a product or service through the different phases of production, including procurement of raw materials and other inputs (World Bank, 2010). Similar definitions are included in the guidelines prepared by FAO, IIED, GTZ, ILO, and USAID.

The analysis can focus on a commodity, a group of commodities or on the final product(s) of the chain. The focus on a commodity (e.g., milk, beef, maize, etc.) is a frequent initial option. Since commodities can be processed and transformed into final or intermediate products, we might need to branch out the analysis into 'subsystems', as our observations progressively lead us down-stream along a chain. Considering the definition stated above, a chain consists of the activities that are performed on farm and off-farm, both up-stream and down-stream from the primary

production stage. For instance, maize chain starts out by looking at the inputs for its production, i.e., the seeds, fertilizers, plant protection materials and farm implements used in maize cultivation (FAO, 2007). Having the initial stage of the chain, the delimitation of the remaining segments can be done by an examination of the product flows (see mapping).

In other words, agricultural value chain means a set of goods and services needed for an agricultural product to move from the farm to the consumers. The chains contain various activities and actors involved, from the production process to delivery of a product to the market. There are different approaches that considered capturing the meaning of agricultural value chain (Rillo and Nugroho, 2016). Supply chain management approach employs a more holistic agribusiness approach of considering the sequence of key activities and their attendant supporting economic activities at the various levels of the chain, such as delivery of agricultural inputs, production and processing of agricultural products, and marketing and distribution of those products. This approach links agriculture with the manufacturing and services sectors of the economy along the supply/value chain and trading network (Rillo and Nugroho, 2016). Moreover, agricultural supply chain management includes a number of processes such as supply management, production management and demand management to ultimately satisfy the customers through a competitive distribution channel. Differently, agricultural supply chain is defined as a set of activities in a "farm-to-fork" sequence including farming (i.e., land cultivation and production of crops), processing/production, testing, packaging, warehousing, transportation, distribution and marketing (Routroy and Behera, 2017). Another alternative approach (Figure 6.13) points out a conscious attempt to encourage involvement and investments in the economic activities in the up-stream (research and development, certified seeds, high-value varieties, farming systems), mid-stream (processing, high- value end uses), and down-stream (packaging, food safety, traceability, branding, targeted markets) segments of the value chain (Rillo and Nugroho, 2016).

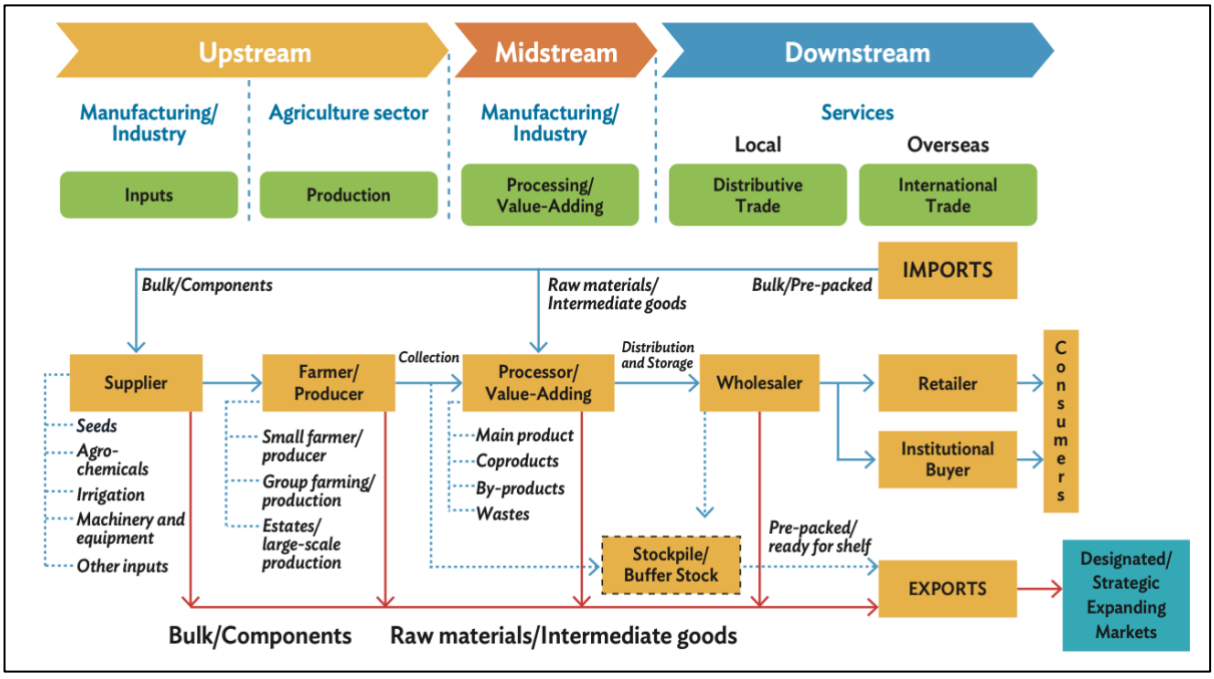


Figure 6.13 Agri-Food Chain Model (FAO, 2007).

Considering the issue in terms of added value in the agricultural food value chain, the value chain is a series of value adding processes which flow across many companies and creates products and services which are suitable to fulfill the needs of customers. Each step in the chain, from basic inputs to consumer goods, serves as a link or stage in the value chain. The value chain framework

emerges as a key aspect in the analysis of the drivers of business success and value creation (Cucagna and Goldsmith, 2018). Overall, the value creation differences between the four chain nodes and the drivers underlying value creation are examined (Figure 6.14).

Stage 1. Empirical evidence suggests that the increase in private investment among Stage 1 firms in agricultural research is due to the establishment and strengthening of intellectual property. For example, effective intellectual property development in the seed and equipment markets allows suppliers to create internationally recognized brands that reflect highly differentiated products.

Stage 2 is the most commodified sector of the value chain. The farm production phase offers low product margins, high price dependence on transactions, and low product differentiation. Companies often operate in competitive markets and seek to compete on cost management and economies of scale.

Stage 3. The process of converting raw agricultural outputs into food and beverage products "adds economic value" to raw goods, but these activities can also significantly alter the appearance, storage life, nutritional value and content of raw materials. A processor's core activity is converting goods into food products, a process that adds economic value to products.

Stage 4. The last stage of the agri-food value chain serves the consumer. One of the main drivers of innovation at this stage for food retailers, restaurants, and hospitality firms is differentiation through service and retail brands to better meet consumer demand. As retail firms strive to support innovations that better serve consumers' needs, up-stream integration into branded food production and private label manufacturing is changing the relationship between phases 3 and 4. There is evidence of increased market power at the retail end of the agri-food value chain because of increased concentration and consolidation in the industry. Retailers' influence on processors, manufacturers as well as the consumer allows the retail industry to gain a competitive advantage and capture more value created along the chain.

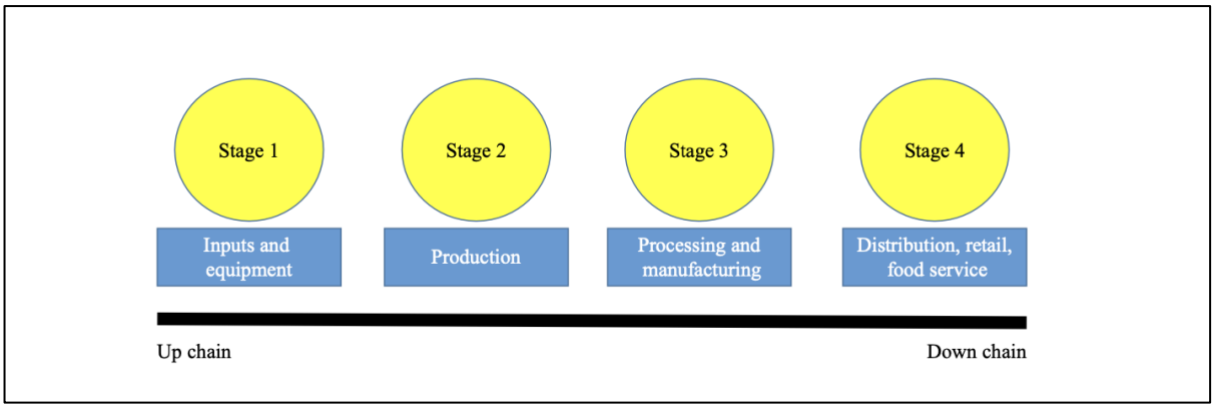


Figure 6.14 The Stages of Food Value Chain (Cucagna and Goldsmith, 2018).

However, agri-food chains represent a complex network of inputs and outputs that link farm production inputs to food consumers. There is a wide range of stakeholders in the chain. At the micro level, many stakeholders are investigated such as feedstock suppliers; agro-chemical manufacturers and suppliers; machinery and equipment manufacturers and suppliers; farmers; produce marketers and sellers; food processors; suppliers of food additives; packaging suppliers; transport companies; food retailers; consumers; and waste processors. Table 6.7 shows some examples of agri-food chain stakeholders (Prugger and Ferro, 2006).

In Table 6.7, farm suppliers, mainly represented by feedstock and agro-chemical manufacturers and suppliers, have at this moment the task of increasing the information about their products and adopting high quality standards. This is related to consumer concerns regarding the effects of some plant and animal selection and breeding programs on the animal welfare, environmental sustainability and health keeping. They are the first step in the food chain and they are the "starters" of the process. Regarding to farmers, they have typically belonged to small-scale independent family operations or are members of a co-operative. The farm sector structure is changing because of some factors such as the amplification of the European Union or the increasing imports from other countries, resulting in an increase of the competition. Consequently, now there is a major output in the raw material production (use of machinery, pesticides, etc.), there is more interest in farmers' training and it has been observed a reduction of agrarian companies (associations, abandonment). More recently, farming is combined with other activities such marketing of their own products. Producers' associations are considered to benefit from economies of scale through cheaper purchases of inputs and access to modern technologies (Prugger and Ferro, 2006).

Farmers are feeling pressure from major food processors and retailers who need better agricultural practices regarding food hygiene and safety, animal welfare, use of agrochemicals and better management of natural resources. In the real process of globalization, as distances increase, transportation and distribution require more comprehensive and more advanced systems to get food to consumers. In addition to the necessary roads and vehicles, not only a fast means of transport, but also an efficient and continuous supply is important. Incorrect or careless handling of foodstuffs during transport can result in damage to cargoes and major losses. This unintentional destruction is often caused by incorrect temperature and humidity settings. An example is the deterioration in temperature control in the cooling chain. Traditionally, food supply and distribution consisted of wholesale traders and retail operators (small artisans, market retailers, street vendors). Today, large, vertically integrated networks of distributors and agro-industrial supply (especially dealing with animal products) and national or international trading companies are evolving. The consumer should be seen as the central element of the food chain and should be considered at all stages of the development of new processes and products. When developing new food products and processes to meet consumer demand to the greatest possible extent, it is necessary to consider the consumer perspective from the very beginning. For consumers, safety is the most important component of their food. Food scandals in the western world have created a sense of insecurity and anxiety among consumers. The consumer now demands more information about production systems (food safety, environmental impact) and food composition (origin of ingredient, quality characteristics of food). In order to respond to this demand, it is necessary to determine the foods and their ingredients, to carry out quality controls and to obtain the relevant certificates. It is necessary to distinguish the importance of traceability from all these. Traceability is the ability to track and trace food, feed, food-producing animals or ingredients at all stages of production and distribution. Traceability ensures that targeted and accurate information about products is provided to consumers (Prugger and Ferro, 2006).

Table 6.7 Agri-Food Chain Stakeholders

	Stage	Agri-food chain link	Dairy Products	Cereal Products	Fruit &Vegetables	Meat Products
UP-STREAM	Raw material production	Farm suppliers' inputs	livestock feed providers; fertilizer, pesticide, veterinary & agro-chemical manufacturers	seed providers; fertilizer, pesticide & agro-chemical manufacturers	seed providers; fertilizer, pesticide & agro-chemical manufacturers	livestock feed providers; fertilizer, pesticides, veterinary & agro-chemical manufacturers
		Farmers	livestock breeding	seed growers	horticultural production	animal husbandry
MID-STREAM	Processing stages	Food Processors & packagers	dairy product manufacture: milk, yoghurt, ice-cream, powder milk, etc.	grain millers, bakeries, pasta manufacturers , breakfast cereal manufacturers	canned, de-hydrated and frozen vegetable based packaged convenience foods manufacturers	abattoirs; butchers; canned, hydrated and frozen packaged meat-based convenience foods manufacturers
DOWN-STREAM	Post processing stages	Logistic	Transport			
		Retailers	milkmen, supermarkets, grocery shops	bakeries, supermarkets, grocery shops	supermarkets, fresh fruit & vegetable markets, green grocers, grocery shops	butcheries, supermarkets
		Consumers	single to family households with various age groups lifestyles, cultures, preferences, incomes			

Source: Authors' elaboration from Prugger and Ferro, 2006

Following Cucagna and Goldsmith (2018), we can examine the impacts firms face from the input stage to retail (or up-stream to down-stream) in the food and agribusiness value chain. The process (given in Fig. 2) in the stages of the agriculture-food value chain is interpreted below in terms of the added value created:

First, value addition levels differ across stages, which means that each stage in VC contributes differently to the process. It confirms that the value addition levels at Stage 1, 3, and 4 are significantly different from Stage 2. For example, Stage 3 contributes the most value in the chain.

Second, the up-chain Stages 1 and 2 attain low levels of value adding. The agricultural input stage (Stage 1) to be a high value-adding node given the presence of input brands and the high level of agricultural research does not meet expectations. Because Stage 1 firms do not effectively add value compared to Stage 2. Stage 1 firms are statistically no different from Stage 2 firms. This also means that more value creation occurs down chain, as opposed to up chain.

Third, It is accepted that Stage 2 firms add relatively little value to the food and agribusiness chain, as measured by capital utilization efficiency.

Fourth, Stages 3 and 4 create significant value. The research study shows that Stage 3 (food processing and manufacturing) exhibits a relatively high level of value addition, compared to up-stream stages, due to strong product differentiation, coordination with retailers, and access to low-cost inputs from the production stage. Moreover, Stage 4 the retail firms with their consumer orientation, need to innovate, and strategic position within the value chain, are a relatively high value creator, compared to up-stream stages. The empirical analysis shows that Stage 4 most efficiently uses its capital; being the largest contributor to the value creation process along the

food and agribusiness value chain. The major finding is that all stages have a positive and significant probability of creating value that a firm creates more value than a firm in Stage 2. Positive probabilities range from the highest being Stage 4 (retail) to Stage 1 (inputs). The probability for a retail firm is 65% higher than Stage 3 (manufacturing), which is 60% more likely than Stage 1.

Fifth, the results confirm that firms with higher levels of intangible assets and goodwill create more value. Also, it is accepted that firms with higher levels of research and development expenditures create more value.

Sixth, the findings show a positive relationship between product differentiation and value creation, which can be interpreted that product differentation drives value creation. Firms with higher degrees of product differentiation create more value.

Seventh, another important finding is that there is a positive relationship between firm size and value creation. Therefore, firm size is a significant determinant of value creation.

Case study: Old Limachino Tomato

In 2015, the Food and Agriculture Organization of the United Nations (FAO), launched the International Year of Family Farming in order to "stress the vast potential family farmers have to eradicate hunger and preserve natural resources". In July of 2015, the Foundation for Agricultural Innovation (FIA, in Spanish), associated with the Ministry of Agriculture of Chile, opened a call for Peasant Family Farming—Valuing the Agrarian Heritage. The Agriculture Research Institute (INIA, in Spanish) in partnership with the Federico Santa Maria University (UTFSM, in Spanish), responded to this call with their project, "Local, health, and sensory value of the Limachino tomato for peasant family farming in Marga-Marga province". The project's goal was the rescue and definitive reappearance to Chilean dining tables of this former icon of the Limache watershed in the Valparaiso Region: The Old Limachino Tomato. INIA was in charge of recovering old limachino seeds from international and national seed banks and from fields inside the Limache Basin through the collecting of the seed material held in producer's hands. Besides, INIA was in charge of recovering the ancestral agronomic management of this type of tomato. UTFSM was in charge of the creation and implementation of a business model for future commerce associated with the fruit. To highlight the enormity of this challenge, the goal was to recover and reintegrate to the market a product that had disappeared 45 years ago. The Old Limachino Tomato was not only about producing and selling a fruit with superior health and sensory traits, but also about selling a product with a strong local identity associated with a rich multicultural, intangible heritage. The project ended formally in January of 2017. It had precisely fulfilled all its specific objectives. The geographic cultivation zone has been established. Over the course of the two-year of the project, 55–60,000 kg of fruit was sold at an average price, which significantly reduced the market uncertainty (Martinez et al., 2021).

The value chain of the Old Limachino Tomato for fresh consumption is a simple system and is mainly associated with small-scale agriculture (Figure 6.15). The value chain starts from the seed (Box 1: seeds), which considers the use of a genuine genetic material. With this material, the seedlings are produced (Box 2: nursery plant process), sometimes this process is carried out by the producers or the companies producing the seedlings. The waste in this process is mainly associated with: use of seed of poor quality, uncontrolled cultivation and environmental conditions. Box 3 (seedling transport) corresponds to the transportation of seedlings from the company producing seedlings to the farmer. The waste in this step occurs when transport

conditions are not adequate. Box 4 (tomato production process + harvest) shows the processes associated with tomato production, such as agronomic management and crop conditions. In this phase, the wastes are principally associated with problems in the agronomic management, occurrence of pests and diseases, climate change, among others, including also the losses in the harvest. Box 5 (packing process), wastes are observed when the storage conditions are not adequate, and the fruit shows deterioration in its physiological state, as well as if the selection prior to storage was not appropriate, quality losses are observed. The process of the fruit transporting corresponds to Box 6 (tomato transport), use of unsuitable transportation means, which presents wastes that are produced by not using an adequate packaging, uncontrolled environmental conditions of transportation means, and excessive transports. Finally, in Box 7 (end consumer), some wastes occur due to the fruit not consumed and to problems of condition and quality for the consumer.

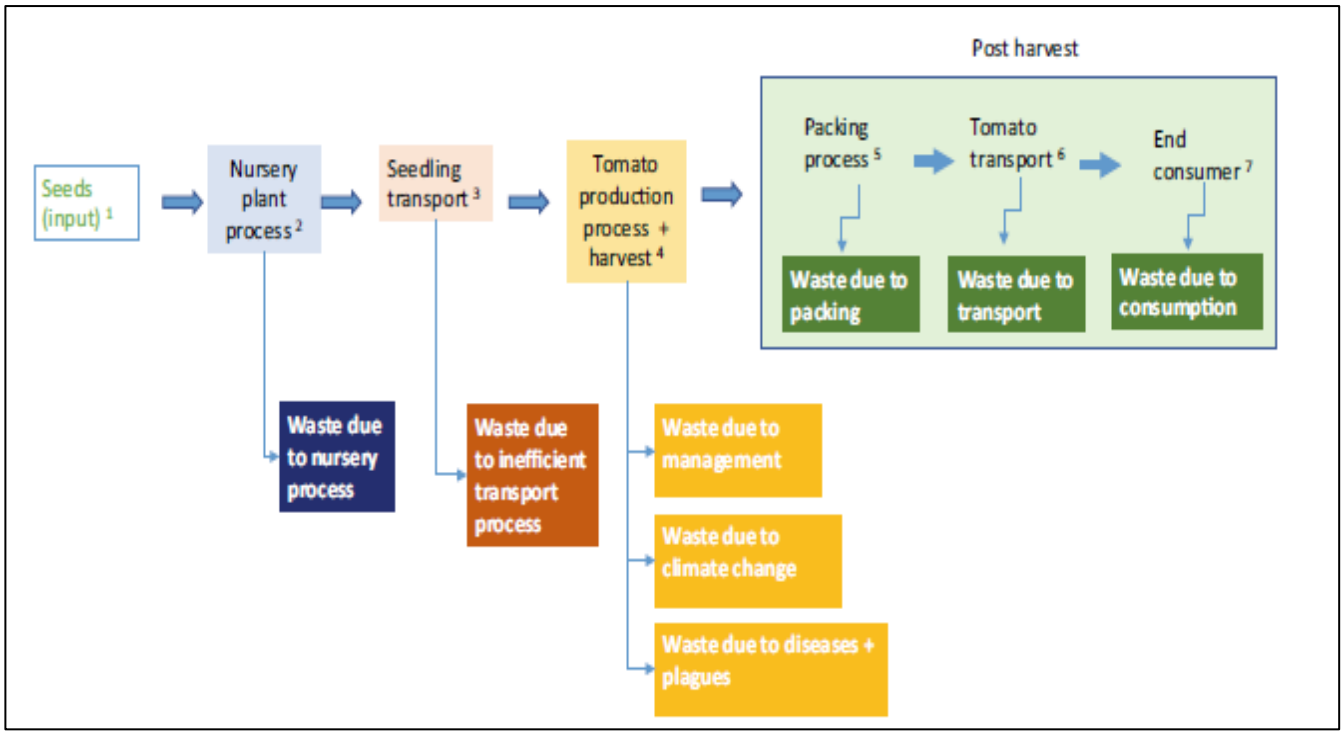


Figure 6.15 The Old Limachino Tomato Value Chain (Martinez et al., 2021).

6.2.2 Product Delivery Channels

A product delivery channel (in other words, distribution channels) is a group of businesses or organisations through which a product (or service) passes until it reaches end consumers. Various actions are performed along a channel to ensure the efficient movement of products. The number of channel actors performing these actions differs for each channel. As the number of actors increases, the channel becomes more complex. Intermediaries (or middlemen) is an umbrella term for the channel actors between producers and final consumers in a product delivery channel. They are usually named after the primary service they provide, such as retailers, wholesalers, assemblers, brokers, distributors etc.

A channel performs various functions that fall into three categories (Heskett, 1976, as referred in Mariadoss, 2017):

1. Transactional functions: buying, selling, and risk assumption
2. Logistical functions: assembly, storage, sorting, and transportation
3. Facilitating functions: post-purchase service and maintenance, financing, information dissemination, and channel coordination or leadership

Intermediaries might perform one function or multiple functions at the same time. Examples include, but are not limited to:

- The wholesaler and the retailer can be the same business (or organisations such as cooperatives)
- Processors might act as a wholesaler or an aggregator.
- There can be more than one wholesaler until the product reaches the retail stores.

As the number of channel actors along a channel decreases, the margin captured and the number of functions performed by each actor may increase at varying degrees. Shorter supply chains are often more beneficial for producers as far as the economic perspective is concerned. In short supply chains, certain functions (especially logistical and facilitating functions) are undertaken by producers or consumers otherwise performed by different intermediaries. For example, suppose a farmer decides to sell his/her product in a local food community. In that case, the logistical functions are performed by the farmer him/herself or by members of the community (end consumers). Channels without any intermediaries are called direct channels (or direct marketing).

The distance a product travels until the final consumer roughly informs about a value chain's economic, environmental and social impacts. As the distance between farm to fork increases, typically, more actors are involved, and the system becomes more complex. Both short and long supply chains have their potential and limitations when sustainability indicators are concerned. Logistical functions in long supply chains often cause higher carbon emissions and waste due to increased food miles and packing and storage necessities to increase the product's shelf life. The shorter distance allows for lower resource use, but this does not mean that short supply chains are more environmentally sustainable in all cases. Recent literature suggests that the resource used per product is often increased in the case of shorter supply chains (Galli & Brunori, 2013). In addition, the renewability of the resource used is important, as well as its quantity. Small and medium-scale producers can benefit more from shorter supply chains than longer chains since the actors in longer chains usually demand large quantities to benefit from economies of scale (Malak-Rawlikowska, 2019). A shorter distance allows chains to function with fewer intermediaries. This, as mentioned above, creates an opportunity for producers to capture more benefits. However, the question of the opportunity cost of their time remains (Malak-Rawlikowska, 2019).

Businesses, including producers, usually rely on more than one supply chain to decrease the risk of a future disruption along the chain. Various factors affect the distribution channel decision, including the available channel options. The characteristics of products such as perishability, size, unit value etc., the necessary storage conditions, the distance between the production area and the end customers, competition, buying capacity of intermediaries, number of intermediaries, end-market size, competition, environmental concerns are the among the key factors which shape the choice of distribution channels.

Product delivery channels are often roughly identified during the initial mapping steps. The quantitative and qualitative characteristics of the channels are often elaborated on in the later stages, depending on the study's primary purpose.

The following variables or tools are often used to excavate more details about the product delivery channels:

1. The value or volume of goods passing through each channel

After a list of actors in the value chain has been created, the connecting paths (i.e., channels) between the actors and the value of goods or the volume of goods passing through these channels are identified (Henning, Donahue & Brand, 2008; Vermeulen et al., 2008). Mapping the identified actors and the channels connecting them regarding information about the volume or value of the goods will make the picture clearer (Henning, Donahue & Brand, 2008; Vermeulen et al., 2008). For example, the busiest or the most lucrative channels can be identified to expand the understanding of the value chain. Figure 6.16 shows how Afghan Dried Fruits & Nuts flow through Indian markets (Henning, Donahue & Brand, 2008). The chart was drawn using the Market Map Tool based on classification and mapping, one of the two tools USAID recommends for analysing channels in the Secondary End-market Research. Figure 6.17 depicts an example from Mexico, where the quantity of production and the percentages of strawberries move through different market channels (Vermeulen et al., 2008).

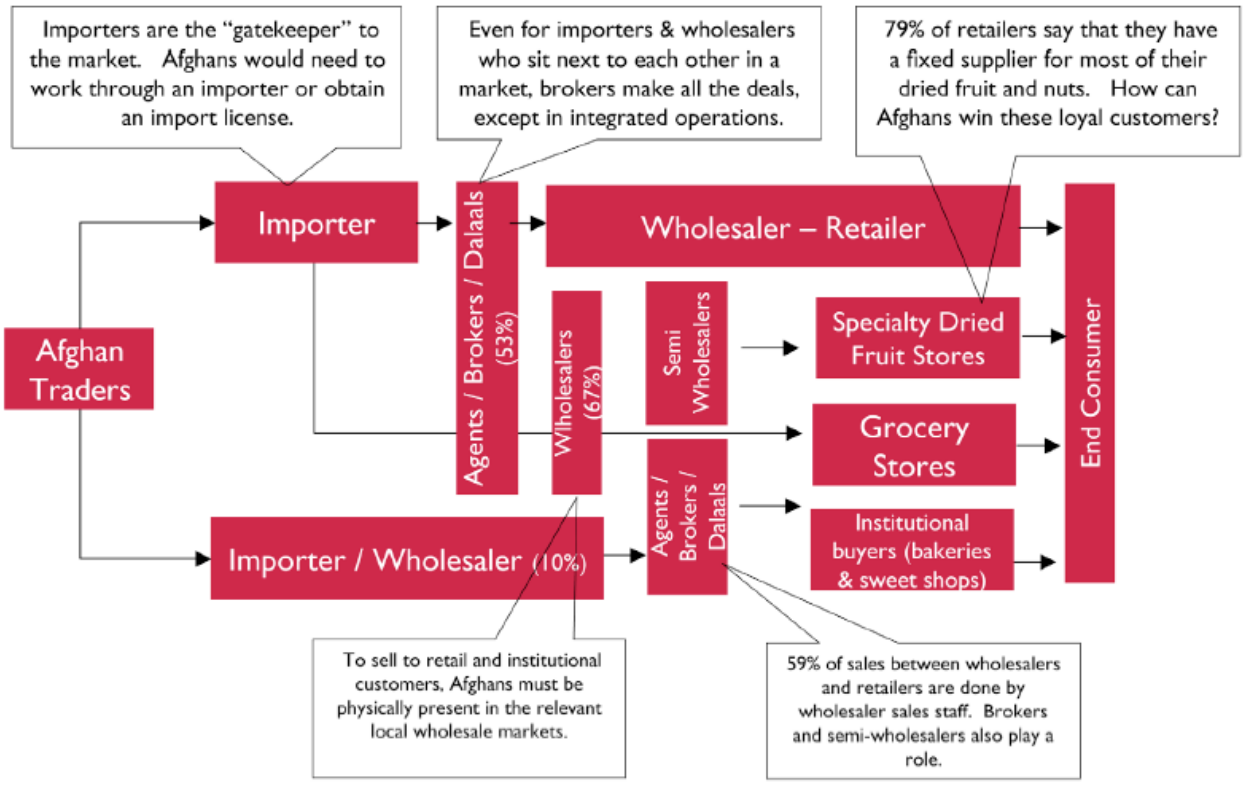


Figure 6.16 Afghan Dried Fruits & Nuts Value Chain Case Study (Henning, R., et al. 2008).

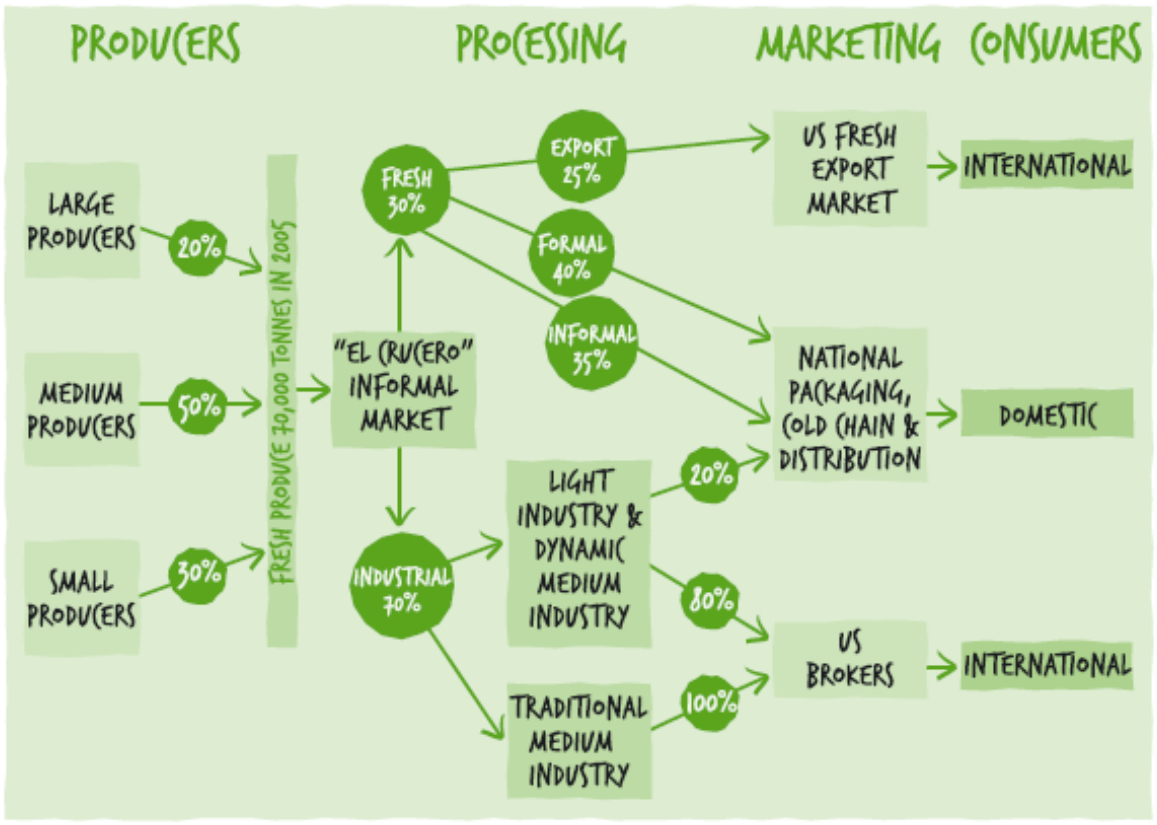


Figure 6.17 Strawberry Value Chain Map, Mexico Zamoro Valley (Vermeulen, S., et al. 2008).

2. Disaggregation of the (group of) actors/channels

When mapping the value chain, disaggregating the actors or channels can provide important insights into the distribution channels in the value chain. For example, information about major buyers that have important differences in purchasing policies or the relative buying powers of each actor can be added to the value chain map (Vermeulen et al., 2008). Figure 6.18 shows a tomato value chain example from Turkey.

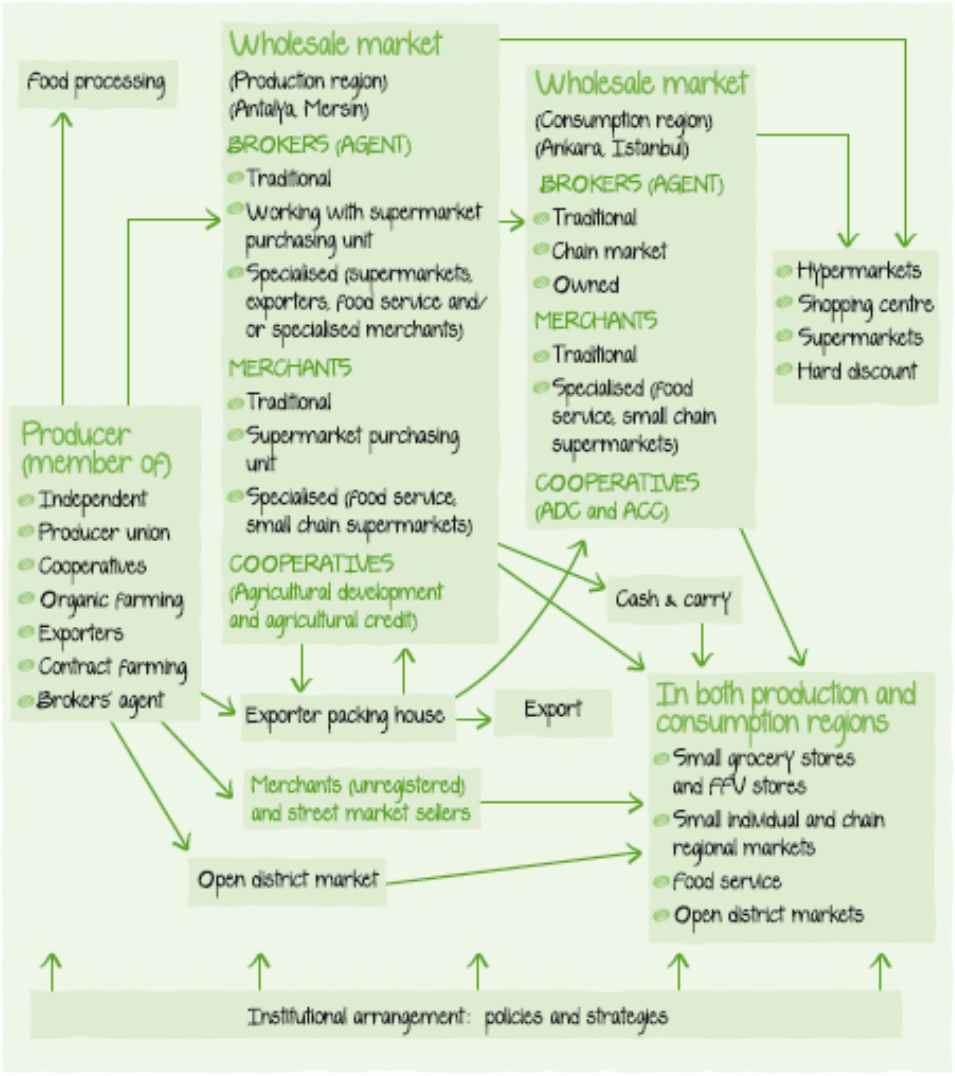


Figure 6.18 Tomato Value Chain Map, Turkey (Vermeulen, S., et al. 2008).

In some cases, a group of actors performing the same activity significantly drive the distribution process. In the study conducted by USDA, a classification that is based on the type of the group of organizations which are driving the distribution process resulted in identifying four different types of distribution models: retail-driven, nonprofit driven, producer-driven, and consumer-driven (Diamond & Barham, 2012). The dominant group of organizations often provide services, such as marketing services, networking, and aggregation, in addition to establishing and growing distribution enterprises (Diamond & Barham, 2012).

3. Periodic changes

The volume and value of products passing through each channel might fluctuate throughout the year. Understanding the monthly, seasonal, or holiday business cycles by mapping the distribution channels regarding demand and supply levels might unlock potential market opportunities (Henning, Donahue & Brand, 2008). Figure 6.19 shows the example of the EU Tomato Market case prepared to explore options for Albania. The chart is created using the Seasonality Analysis Tool, one of the two tools USAID recommends for analyzing channels in the Secondary End-market Research. The chart shows that the period of high import prices and low tariffs can potentially be

the right time for Albanian producers to sell their tomatoes to the EU if they have enough supply (Henning, Donahue & Brand, 2008).

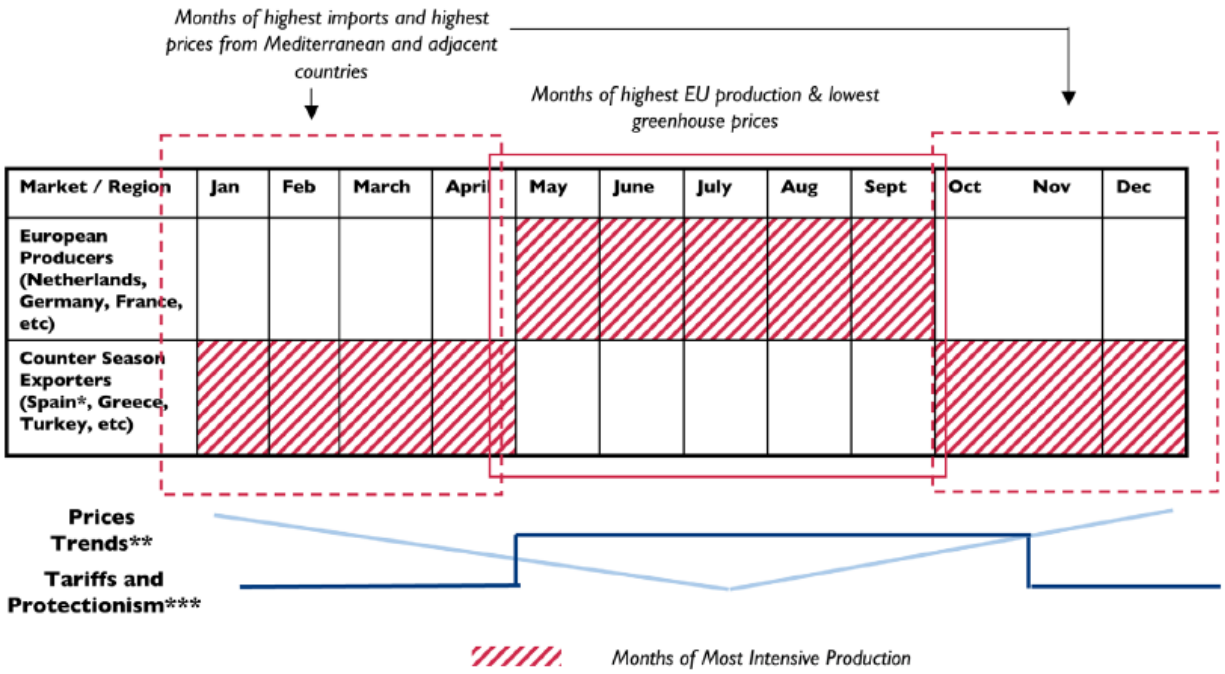


Figure 6-19 EU Tomato Value Chain for Albania Case Study (Henning, R., et al. 2008).

4. Identification of opportunities and challenges within the distribution channels

Information about the bottlenecks and opportunities within distribution channels (Bernet, Thiele & Zschocke, 2006), existing limitations and possible options for collaboration among the chain actors (Bernet, Thiele & Zschocke, 2006) or the relevance of distribution channels for accessing new markets (ILO, 2021) can help reveal the commercial potential of the product. The most used techniques are surveys, focus groups, and interviews with key distribution actors.

6.2.3 Price Transmissions

Price transmission is under the scopes of the Guidelines investigated here such as M4P: Making VCs work better for poor in the part of MAPPING activities, GIZ-GTZ: Guidelines for VC Selection in the part of Comparative advantage of production, FAO: Developing sustainable food VC in the part of Value Chain Mapping and FAO:VC analysis for Policy making in the part of transactions with other economies: export-import parity prices.

Economists have long been concerned with the transmission of market shocks through the various stages of the supply chain, or through horizontally related markets. These are called as Vertical Price Transmission and Horizontal Price Transmission.

Vertical price transmission explains the links and interactions between farm, wholesale and retail prices. The nature of these process can identify the nature of competition in the marketing chain. Hence, the vertical price relationships have featured prominently in recent studies as commodity markets have become more highly concentrated at each level and integrated across levels. Vertical price relationships are typically characterized by the magnitude, speed and nature of the

adjustments through the supply chain to market shocks that are generated at different levels of the marketing process. In the context of this definition, the underlying links across agents at different levels of activity, from production to consumption and vice versa, may be summarized in a single set of measures that define the speed and size of the impacts of a shock in prices at one level on the prices up- or down-stream (Vavra and Goodwin, 2005).

Horizontal (Spatial) transmission usually refers to price linkages across marketplaces (spatial price transmission). It can also concern the transmission across different agricultural commodities (cross-commodity price transmission) from non-agricultural to agricultural commodities and across different purchase contracts for the same commodity typically, from futures to spot markets and vice versa. The key underlying theoretical explanation of spatial price transmission is the spatial arbitrage and Law of One Price (LOP). On the contrary, cross-commodity price transmission, the co-movement of prices is mostly driven by the substitutability and complementarity relations among the products, while transmission from non-agricultural to agricultural commodities is prevalently due to the underlying production technology and cost structure, but also due to the complex drivers (expectations, speculative behavior, etc.) of financial markets which also underlies the linkage between spot and futures prices (Listorti and Esposti, 2012).

Prices both vertically and horizontally transmit as symmetric or asymmetric. Prices is resulted with the changes of absolute size and time in symmetric transmission. This happens in perfect competition and monopoly condition of the market. In contrast to Symmetric price transmission, Asymmetric Price Transmission is said to exist when the prices are not homogeneous with respect to characteristics external or internal market conditions, global dependencies, share of income spent for a specific product, etc. Asymmetric price transmission includes consideration of non-competitive market conditions. Increasing of prices transmits faster and much more to up-streams and down-streams than the decreases. This is called positive asymmetry. Decreasing of prices transmits faster and much more to up-stream and down-streams than increases. This is called negative asymmetry (Cramon-Taubadel, 2002).

The data availabilities figure out the concept of the price transmission. Most of the analysis are based on the farm-gate and retail level. Vertical price transmission from farm-gate to retail explains with the speed and size of the impacts of a shock in prices. Data frequency plays an important role to identify and quantify price transmission. Hence, lower frequency price is not preferable (Table 6.8).

Table 6.8 Some Case Studies Reviewed on Price Transmission with The Data Set Used

Vertical/ Horizontal	Product	Country	Data and Frequency	Level of price	References
Vertical	Milk, Wheat, Potato, Onion, Rice,	Slovakia Germany Russia Indonesia Tanzania Bangladesh India Norway	Time series price elasticities: daily/weekly/monthly	1)Farmgate-Processor-Retailer 2)Wholesale-Retailer 3)Farmgate-Retailer	Kharin etal. (2017), Loy etal. (2015), Karin, S. (2021), Fitria etal. (2020), Mgale, Y.J (2020), Deb etal. (2020), Paul and Karak (2022), Gizaw etal. (2020),
Horizontal	Bean Dairy Rice Coffee Maize-Sorghum -millet	Mexico-US Russia Nigeria Indonesia Nigeria	Time series price elasticities: daily/ monthly/annually	1)Domestic wholesale prices-import prices 2)Wholesale prices in different local markets 3)Prices of local and imported products 4)Farmgate price and World price 5)Cross-commodity prices	Lopez, A.A. and Huhar, A. (2020), Kharin, S.(2019), Akpan atal. (2016), Kamaruddin (2021), Blay, J.K. etal. (2015),

Impact of Price Transmission on Value Chain

The effects of the price transmission to Value Chain explain with the symmetry and asymmetries which indicate a balanced and unbalanced relationship between the price increases and decreases for a production stage through the retailer stages. Moreover, if the price transmission between the specific stages of the supply chain is asymmetric, then the price changes at the production level are not passed to price changes at the processing and/or retail level quickly or fully as in the case of a symmetric transmission. Asymmetry could be negative or positive in different level of supply chain. A positive price asymmetry occurs when an increases in prices at farm level is fully or quickly transmitted than price decreases. But a negative price asymmetry occurs when a decreases at farm level passes on more quickly or fully to the final consumer than price increases (Bor, etal, 2014). Consumer is worst off in the situation of positive asymmetry and better off in the situation of negative asymmetry.

It is explained that the existence of long-run asymmetric price transmission within wheat-flour supply chain in Russia. Significant reason of this asymmetry is imperfect competition among agents between farms and processing companies and the resulting market power. The grain producers have huge export-oriented production and market power and react more quickly to increase margins than the reducing (Kharin, S., 2021). Price transmission in potato supply chain has negative asymmetry which potatoes prices drop at farm levels are more rapidly transmitted at the retail level (Fitria, et al., 2020).

Potato price transmission in Lithuania, Long-run increases and decreases of prices are transmitted with similar intensity and shocks are fully transmitted between farmers and retailer (Jurkenaite and Paparas, 2018) Red chili price transmission is asymmetric in the producer-wholesaler and wholesale-consumer in the short and long term in Indonesia. Traders have greater market power and this is resulting by the increasing prices at traders is higher than producers. So, producers get prices that are much lower than the prices paid obtained by the Merchant (Surbakti et al., 2022). Rice market in Togo, the results mean that farmers are the beginning of the marketing chain do not benefit from periods of price increases or consumers price decreases on the global market.

This can lead, rice farmers to subsistence farming while in the long run the goal of the state authorities is to achieve at the national level self-sufficiency in rice (Lanie, T., 2018). In Brazilian rice market, the transmission of the price falls is greater than increases when the retail sector is considered, making negative asymmetry in retail-producer and retail-industry relations (Zanin et al., 2020). It has been founded for Turkish meat market that the magnitudes of pass through of a price shock between different levels of supply chains are considerably large, and the largest effect is occurred from wholesale prices to retail prices (Günçavdı, et al., 2021). Again, for the Turkish fluid milk market case, there is asymmetric price responses on the base of retailers and processors. Due to the existence of positive price asymmetry in farm-retail price transmission in the liquid milk market, the retail prices adjust more quickly to increases in raw milk price than to decreases implying serious welfare losses to the consumers (Bor, et al., 2014).

6.2.4 Quality Control

Quality control is a part of Quality management together with the quality assurance, quality standards. Quality control is a process by which entities review the quality of all factors involved in production. ISO 9000 defines quality control as "A part of quality management focused on fulfilling quality requirements". This approach places emphasis on three aspects: 1) Controls, job management, defined and well managed process, performance and integrity criteria, and identification of records, 2) Competence, such as knowledge, skills, experience and qualifications, 3) Soft elements such as personnel integrity, confidence, organizational culture, motivation, team spirits, quality relations (https://en.wikipedia.org/wiki/Quality_control).

The process of the Quality Control has been defined by Jraisat and Sawalha, 2012 with 13 different elements (Figure 6.20).

Figure 6.20 Conceptual Framework of Factors on Quality Control Process

(Jraisat and Sawalha, 2013).

There is a strategic relation between Quality management (QM) and value chain. The distinctive element of quality management in the value chain is to create tools through which are carried out continuous and systematic analysis and improvement of the value chain processes resulting with the added valuation. In this respect, the value added is measured by systems of: i) indicators on financial performance, ii) increase of market shares, iii) costumer satisfactions, iv) improve of environmental performance and v) social responsibilities (Popescu and Dascalu, 2011).

Improving food-chain sustainability is a complicated procedure incorporating economic, environmental, and social dimensions that must be integrated into a coherent system to be successful. Quality is a crucial component of this system as it contributes to achieving economic growth. Increased attention has been shifted towards food quality in later years, particularly in the EU, due to the dynamic and fluctuating demands of the market. Specifically, changes in the food chain composition (more complex food chain, overpriced food services), demographic composition, social status, consumer behavior, and lifestyle. The EU recently designed its Common Agricultural Policy context to emphasize the 'quality turn' in the food supply chain: moving towards a food production with standardized quality conventions and supporting localized and eco- friendly products on trust and tradition. Ultimately, this may have specific socio-economic impacts (at a regional and farm level), various environmental effects, and increased interest on behalf of the consumers (Mattas et al, 2022).

To service high-value international markets, many agrifood value chains in developing countries are required to transform to meet the strict quality and safety standards. Miller and Jones (2010) elaborated further, stating that the agrifood value chain progresses towards a modern system that delivers higher market value via increased processing and stringent quality and safety standards.

Sustainability in food VCs is a dynamic concept. The generation of added value is not a one-off shift to an equilibrium at a higher level, but rather sets in motion or speeds up a process of growth and structural transformation. Increased incomes, higher product quality and lower prices fuel the demand for food products. FAO (2006) defines food security as having four dimensions: access (having the means to secure food), availability (food supplied in sufficient quality and quantity), utilization (healthy living through diet, sanitation, and access to clean water and health care) and stability (continuous access, availability and use) (FAO, 2014).

The increasing of value added can be provided by the quality control tools in which the objectives of BioValue project are subjected to augment for biodiversity. Quality control tools generates schemes which has to be implement between up and down-stream actors. Bray and Neilson (2017), amongst others, demonstrate how certification helps smallholders become more productively integrated into value chains, which in turn enhances access to the services and inputs needed to become compliant of GAP.

These are generally in line usual practices such as Certification of Organic, Global Gap, Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI). These are part of EU's quality policy, which aims at protecting their unique characteristics, linked to their geographical origin focusing on production and consumption pattern that respect natural resources, avoiding depletion of resources and environmental degradation (https://www.strength2food.eu/2021/04/26/strategic-guide-on-sustainable- food-quality-schemes/- Accessed on 13.06.2022)

Certification (i.e., GAP) helps to satisfy sustainable market requirements, create transparency, and guide smallholders to integrate into a high-value market.

Globally, many countries are prioritizing to improve food control systems by the way of food laws as well as food hygiene regulations/standards. However, food quality/safety is still confronted with challenges, and some examples can include:

a) importation and exportation of food
b) street foods
c) food transportation
d) zoonotic pathogens and
e) chemical agents in foods.

From the global viewpoint, it can be said that the consumers' persistence for food safety has contributed to facilitating the food industries to vigorously pursue the implementation of various (food safety) standards, like British Retail Consortium (BRC), International Featured Standards (IFS), Hazard Analysis of Critical Control Points (HACCP) as well as ISO 22000:2005.

As good practices contribute to protect the production process within the agro-food industry/sector, the QC plays a vital role to make the operational activities work effectively and efficiently. Depending on the purpose, the focus of good practices can be of private or public aspects, despite the complexities associated with the food supply chain. Hazard analysis and critical control point (HACCP) is increasingly becoming popular in the developing countries, as a means of assuring the food quality safety. In addition, HACCP is also very relevant to religious food safety. In the situation of export and across trade barrier(s), food safety standards have challenges, like;

a) delicate nature of fresh food product regional trade
b) role of farm-to-table approaches that assure safety
c) the role of the public sector between nations to facilitate trade
d) potential role of nations based on the agreement to resolve disputes and determine equivalencies of standards. In the European market also, food quality standards remain critical in meeting consumers'/regulatory bodies' requirements. Table 6.9 shows some findings by different researchers which concentrated the application of quality schemes in different countries.

Table 6.9 Some Case Studies Reviewed on Quality Control Schemes

References	Objective/purpose of review	Major sections covered
Wongsprawmas, Canavari, and Waisarayutt	To describe and analyze current situation of good agricultural practices (GAP) standards implemented in fresh (agro-food) produce production in Thailand	Law and regulations regarding to food safety in Thai food production industry - GAP scheme adoption in Thai fresh produce production -Comparisons of GAP standards; and - Challenges in adopting food safety assurance system in Thai fresh produce production.
Kibe and Wanjau	Explores quality management systems and their influence on performance of food processing firms in Kenya	-Food safety assurance systems -Hazard analysis critical control points (HACCP) -Seven principles of HACCP -HACCP plan -Organizational Procedure -Conceptual framework; and -Critical review
Raspor, P. and Jevšnik, M	Analyses good practices at different levels of food production, distribution and consumption.	-Good practices from producers to consumers -Food safety parameters -Food safety dilemma of consumer -Good nutritional practice from producer to consumers
Da Cruz, Cenci and Maia	To present information about main factors responsible for the elaboration of quality assurance system for produce plants of food industry	-Quality assurance -Good agricultural practices (GAP) -Good manufacturing practices (GMP) -Sanitation standard operating procedures (SSOP) -Hazard analysis critical control points (HACCP); and -Future prospects
Doyon, G.; Lagimonière, M	To focus a better understanding and defining food quality, entities and system component	-Briefs about quality assurance, GMP, HACCP, Food safety, audit, risks and certification -Risk analysis tools for quality management are traceability system; and -Traceability tools and definition, concept, principles and guidelines/standards

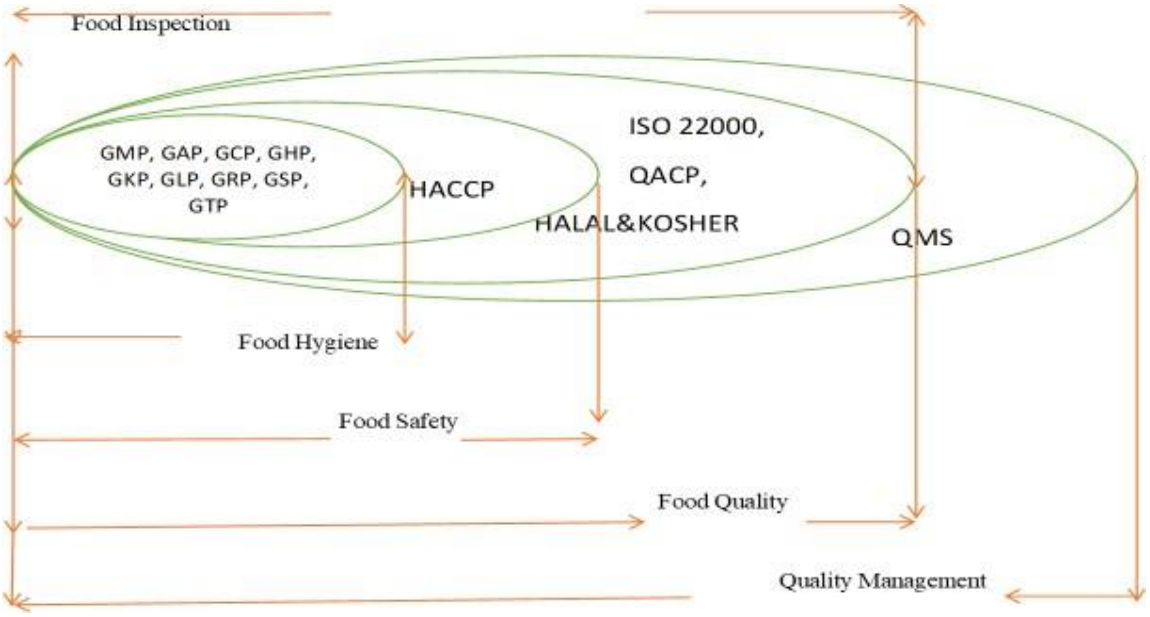
Other quality standards associated with agro-food industry

The ISO quality standards used in agro-food industry

Focused on quality health/safety, the key objective of ISO is to promote the standardization of the given production process. Applying the ISO system to a food unit increases the insight(s) about both effectiveness and efficiency, not only in cost savings but also in both customer satisfaction and maintaining improvements.

The ISO 9000 family of quality standards, among the most widely known of the ISO standards, constitutes a variety of QM facets. By guiding and supporting both companies and organizations, the ISO 9000 quality standards utilized can provide tools that are required to ensure the products/services are consistent with the customers' needs, for the continued improvement of the overall organizational quality. With QM as the focus, the ISO 9000 quality standards would apply to the different establishments regardless of branch, product, or service. The ISO 9000 quality system series constitutes the following quality standards:

a) ISO 9000 – the basis of QM terminologies and systems
b) ISO 9001 – specifies requirements concerning QM systems
c) ISO 9004 – specifies guidelines for improving an already implemented QM system



GMP = Good Manufacturing Practice; GAP = Good Agricultural Practice; GHP = Good Hygiene Practice; GLP = Good Laboratory Practice; GRP = Good Retail Practice; GSP = Good Storage Practice; GTP = Good Transport Practice; HACCP = Hazard Analysis and Critical Control Points; QACP = Quality Assurance Control Points; QMS = Quality Management System; ISO = International Standard Organization

Figure 6.21 A Diagrammatic Representation of Relationship Between GMP, GAP, GHP, GCP, GKP, GLP, GRP, GSP and GTP, connecting with HACCP, QACP/Halal/Kosher and QMS, within the Respective of Food Hygiene, Safety, Quality and QM (Sikora, T. And Strada, A., 2006).

To implement QM production processes, there has to be an increased level of product quality robustly focused to ensure consumer satisfaction, which is among key facets that underpins the effective working of agro-food industry/sector with such programs as GMP, GHP, QACP, GAP, GCP, GKP (Good Kitchen Practice) and HACCP. Although GHP and GMP have similar scope, both follow the principle of 'write down how you do it, do as you have written it down'. Whereas QA/QM procedures depend exclusively on the agro-food unit, all hygiene- sanitary requirements have to comply with the existing national regulatory body. In the QM context, HACCP systematically targets the implementation of food safety via the QA principle, which makes each food company, enterprise/production line to adapt its QACP unique. Useful examples of QM maintenance can include: (a) management review; (b) internal quality audit; (c) document control; and (d) quality record- keeping (Doyon, G., et al. 2006)). In addition, if QM were to be based on ISO 9000 standard, it could cover such aspects as: (a) management of the organization; (b) management of resources; (c) process of product realization; (d) measurements; (e) analysis; and (f) improvement. Strengthening and essentially, sustaining the QM within the agro-food industry signals its usefulness, despite being a non-obligatory (that is, voluntary) system, which someday would eventually become the de facto requirement. From the above-mentioned, QM remains very promising to coordinate the implementation of food hygiene quality safety standards and its related processes (Figure 6.21).

Specifically, kosher and halal, are equally safety standards in their own right, can be seen placed alongside the QACP. To reiterate, 'assurance' relates to product quality, and involves QA together with GHP, GMP, HACCP up to QACP, whereas 'management' relates to the establishment's/unit's overall layout/organization with respect to product quality, which connects through quality management system (QMS) to ISO 9000, ISO 22000, etc. It is to improve the food product quality that the integration of quality standards happened. For example, the ISO 22000 integrated both

ISO 9001:2000 and HACCP system, which made the food quality and safety standards more effective (Figure 6.21).

In developed countries, quality control measures to ensure that food products meet certain safety and quality standards play a key role in agricultural processing. These measures include testing for bacterial contamination, measuring the amount of fat, protein, and other nutrients, and inspecting plants, livestock, and production facilities.

However, food quality control in agricultural value chains in developing countries, where agricultural production tends to be dominated by smallholder farmers, presents particular challenges. Although formal contracting between farmers and agricultural processors is becoming a norm in some developing countries, many smallholders continue to market their products through informal channels. In such cases, a processor who buys products from a smallholder may be the first actor in developed countries, food manufacturers use both internal and external quality control. There is also some evidence that external quality control is becoming more prevalent.

Quality control can be divided into two key steps: acquiring information about product quality and acting on this information by preventing defective products from reaching consumers. Because food products have many experience and credence characteristics (experience characteristics being those about which consumers learn from their own consumption experience and credence characteristics being those which consumers can only learn from third parties), consumers may have potentially two (related) concerns when purchasing food. The first is whether the agricultural firm invests in monitoring to determine if its food product meets quality standards. The second is whether the firm appropriately reacts to this information (https://www.ifpri.org/blog/quality-control-agricultural-value-chains-and-external-certification).

Even if the monitoring technology is the same in both monitoring regimes, incentives to engage in appropriate quality control are not the same for internal and external monitors. Under internal quality control, the firm incurs two types of costs:

1- the direct cost when it invests in learning about quality through testing, audits, and inspection;

2- the opportunity cost when it keeps defective products from being released into the market.

On the other hand, a third-party monitor incurs only the direct cost; however, this external monitor – be it a private entity or a government agency - must also earn a premium to be willing to engage in appropriate quality control. Taking into account the cost of providing incentives to an external monitor, the model predicts that it is more profitable and efficient for large firms to engage in internal quality control, while small firms are better off using external quality control and certification. The model also shows that the modes of communication between the external certifier and the firm and between the external certifier and consumers, as well as potential economies of scale in external certification, are important determinants of the optimal mode of quality control (Saak, 2017).

Quality control Evaluation for Selected Value Chains

In modern agricultural value chain, erect supermarket distribution centers as the key point for a one-stop quality detection. Internal quality control can be improved by quality system certification. By establishing testing standards, testing processes, testing equipment, testing

personnel and testing methods, the quality control procedures can be simplified, and the food safety of modern agricultural supply chain can also be improved.

There is an important relation between quality control and value chain. The distinctive element of quality control in the value chain is to create tools through which are carried out continuous and systematic analysis and improvement of the value chain processes resulting with the added valuation. In this respect, the value added is measured by systems of indicators on financial performance, increase of market shares, costumer satisfactions, improve of environmental performance and social responsibilities (Popescu and Dascalu, 2011).

The recent changes in agri-food value chains have led to an increased attention paid on product quality. Meeting quality requirements including phytosanitary standards seem to be a condition for participating in the global value chains and to get access to high-value markets in developed countries. It becomes also a condition for serving local urban consumers that are increasingly supplied by supermarkets and consume more agro-processed food. Quality attributes of agricultural products encompass a variety of elements such as appearance, taste, nutritional value, chemical composition, ingredients, methods of production, origin or safety and health related characteristics. These attributes may be relevant all along the supply chain or solely at a given stage, on a specific market where they may give rise to differentiation strategies. Appearance is a search attribute that may necessitate some sampling to be correctly assessed. Taste is clearly an experience attribute that is subjective and may vary across consumers. Nutritional value could be considered as in-between experience and credence attribute. Chemical composition could be a credence attribute on the final market but a search attribute on wholesale markets where buyers may have access to the technology necessary to discover the chemical composition of what they buy. Credence attributes such as, driven by final consumers' demand, markets have put a recent emphasis on quality attributes related to the geographical origin of production, to the use of organic methods of production, to the fulfillment of fair-trade standards or to the absence of child labor.

The variety of quality attributes that consumers value as well as the increasing importance of food safety give a central role to quality standards, verifiability and traceability along the supply chain. As an effective quality control tool complied with legislation in food industries, traceability was applied to improve the safety of food and the confidence of consumer, as well as to connect producers and consumers (Aung and Chang, 2014; Dabbene et al., 2014; Regattieri et al., 2007). Certification of a product, such as organic food, increases consumer's confidence, especially in the health food market. Practically, small stakeholders cannot afford these certifications. On the other hand, companies involved in VCs 8 to 10, who deal with large amounts of products for high quality markets, are always certified. For agricultural cooperatives, certifications are always not certified. However, without a powerful regulatory authority, and weak self-regulation, the processes of the individual stakeholders are generally not well-regulated. Conventional production relies on chemical pesticides and biocides for pest and disease control, and chemicals will be applied 8 to 10 times during an annual production cycle. Independent farmers tend to apply excessive amounts of chemicals, which leads to problematic residues. Furthermore, a few farmers paid little attention to the safety interval before harvesting. So selected value chains have been considered with effective control tools like traceability, certification, control, pesticide and Sulphur residue, taste, nutritional value and appearance. When it is evaluated for selected value chain guidelines, VCA4D, ACIAR, GTZ-GIS, FAO Developing Sustainable food value chains, UNIDO, IIED and USAID have traceability, certification, control and pesticide and Sulphur residue (Table 6.10).

Table 6.10 Quality Control Evaluation for Reviewed Guidelines

Guidelines	Traceability	Certify	Control	Pesticide Residue	Sulphur Residue	Taste	Nutritional Value	Appearance
1.ILO-Value Chain Development for Decent Work	No	No	No	No	No	No	No	No
2.VCA4D: Value Chain Analysis for Development	Yes	Yes	Yes	Yes	Yes	No	No	No
3.ACIAR- Australian Center for Int. Agricultural Research	Yes	Yes	Yes	Yes	Yes	No	Yes	No
4.GTZ/GIS-Guidelines For Value Chain Selection	Yes	Yes	Yes	Yes	Yes	No	No	No
5.FAO- Developing sustainable food value chains	Yes	Yes	Yes	Yes	Yes	No	Yes	No
6.FAO VC Analysis for Policy Making	Yes	No	No	No	No	No	No	No
7.UNIDO- Un. Nat. Industrial Development Organization	Yes	Yes	Yes	Yes	Yes	No	No	No
8.IIED – Int. Institute for Environment and Development	Yes	Yes	Yes	Yes	Yes	No	No	No
9.M4P: Making VCs Work Better for the Poor	No	No	No	Yes	Yes	No	No	No
10.USAID – United State Agency International Development	Yes	Yes	Yes	Yes	Yes	No	No	No
11.GFU-Promoting VCs of Neg. and Underutilized Species	No	No	No	Yes	Yes	No	No	No
12.CIAT - Centro International de Agricultura Tropical	No	No	No	Yes	Yes	No	No	No
13.FAO – Rapid Appraisals	No	No	No	No	No	No	No	No
14.CIP-International Potato Center	No	No	No	Yes	Yes	No	No	No

Source: Authors' elaborations from guidelines reviewed.

6.2.5 Investment Planning

Investment planning is the process of identifying financial goals and converting them through building a plan. Investment planning is the main component of financial planning. The investment planning begins with identification of goals and objectives. Then, it is needed to match those goals with the available financial resources. There are some benefits of investment planning. Investment planning provides some benefits to investors such as efficiently manage of income, financial understanding for the individuals, increasing living standards, income security for the families. An investment plan consists of the seven steps as follows: 1) Moving the saving 2) Setting the financial goals 3) Analyzing the risks, 4) Creating portfolio, 5) All types of investment options, 6) Establishing assets allocation, 7) Decision on investment.

Investment planning shapes with the internal and external factors in the sectors/national and global economy. Internal and external factors relate with the data of feasibility which are economic, technical, legal considerations. Internal factors are mostly the economics of resources used and the outcomes results of the investment. These are generally economic and financial results of the investment which are named as NPV (Net Present Value), IRR of investment (Internal Rate of Return), Payback Period, Break-even point of the investment resulted by Costs and Benefits analysis; and external factors are the factors which influence the conditions of legal, macroeconomic and global economic conditions of the sectors/economies. The investment conditions that influence the investment decision are given as follows.

Internal factors

The analysis of internal factors can be divided into market determination, raw product supply and the production process (Schermerhorn, R. W., 2009). These are the information that is answered into the investment plan.

A. *Market Determination -- determines potential market for the proposed product.*

1. Consumption: consumption trends of the proposed product and other competitor products.
2. Markets: type, location and cost of serving potential markets.
3. Distribution system: type, method and cost of distribution system for the product.
4. Market entry: method and cost of introducing the product to consumers.
5. Buyers: type of buyers and requirements and costs of selling to these buyers.
6. Selling arrangement: type of selling arrangements including delivery schedules, pricing and payment schedules.
7. Prices: expected prices for the product.

B. Raw Product Supply -- determines economic availability of sufficient raw product.

1. Minimum economic size of controlling unit: cost analysis of existing plants or synthesized models.
2. Plant requirements: quantity of raw product to support controlling unit.
3. Availability of requirements: availability of quantity and suitable quality at an acceptable price.
4. Assured supply of requirements: raw product supply can be expected in the future.

C. Production Process -- determines facility needs, capital and financing requirements, and potential costs and returns.

1. Facility needs: specific facilities (buildings, equipment and rolling stock) required.
2. Investment capital needs: initial investment requirements for facilities.
3. Labor needs: specific quantity and types of labor required.
4. Cost of operation: budgeting to include costs of labor and management, raw material and operational and fixed components.
5. Profitability. potential profit by estimating returns and comparing with cost budgets. Also includes break- even analysis and preparation of projected income statement, balance sheet and cash flow statement.

External Factors

These are the factors which depend on the investment climate in the economies. A complete feasibility study analyzes the availability of facilities and services that the firm feels are essential to create an acceptable environment in which the plant can operate, and its management and labor force can live. This phase of the feasibility study deals with factors affecting the location of the facility. These factors are considered after the general location, as affected by supply of raw product and availability of markets, is determined (Schermerhorn, R. W., 2009).

a. Availability of services: adequacy and cost of required services such as utilities, financial services and educational services.
b. Legal structure: type of governmental policies, such as taxations, support policies, sanctions, customs duties
c. Availability of infrastructures: adequacy and cost of facilities to be used by the firms.
d. Macro-economic indicators: Inflation rate, Currency rates, Price indexes, Growth, etc.

Investment decision is a last stage of the investment planning which concerns about total results or productivities, or benefits obtained from all sources used in the project for the community or the economy/sector as a whole. The decisions taken on investment either it is positive or negative

is shaped by some economic and non-economic indicators. These are given in the following table with the case study results (Table 6.11).

Table 6.11 The Indicators on The Investment Decisions by Case Study Results

Product	Country	Indicators used	Reference
Cabbage	India	Cost concepts, Input-Output ratio, Net returns, cost of production,	Patel, H., Pundir, R. S., Macwan, J. (2021)
Mentha	India	Input-output analysis	Agarwal, D., Singh, J. M., Horo, A. (2022)
Seed	East Java	Revenue-cost ratio, Cost-Benefit ratio, Net Present Value, Internal Rate of Return	Retnoningsih, D. (2017)
Cherry	Turkey	Fix and variable costs, Net income	Bilgili, G. Etal(2019)
Tomato	Turkey	Fix and variable costs, Gross return, net Return	Ucar, K., Engindeniz, S. And Palkovic, J. (2020)
Different sectors	Poland	Growth rate, interest rate, tax policy, legal barriers, environmental regulations, trust in institutions	Bialowolski, P., Weziak- Bialowolska, D. (2014)
Flower crops	India	Fix and variable capital, Fix and variable costs, Net Returns, Net Present Value, Benefit-Cost Ratio, Internal Rate of Return,	Sharma, et al., 2014
Homemade Chocolate	Indonesia	Total cost, Total revenue, Fix and Variable costs, Payback period, Net present value, Internal rate of return, Profitability index	Halid, and Mokodompit, 2017
Tomato	Pakistan	Fix and variable costs, net income	Malik, A.M., Maghal, K. M. (2018)
Dragon fruit	India	Net Present Value, Benefit-Cost ratio, Internal rate of return	Kikon, P.L. etal (2021)

The given indicators both economic and non-economic side of evaluation are included also in the guidelines analyzed before: VCA4D, 2018; GTZ, 2015; FAO SFVC, 2014; FAO VC, 2013; M4P, 2008.

Impact of Investment Planning on Value Chain Agents

Investment planning is a process which is impacted by economic, financial and regulatory framework on the base of the country, sector, products, area/region called as investment climate/environment. Investment planning uses some variables about the prospective investment by using some economic evaluation techniques and financial ratio analysis which are given in the previous section of the text. These variables can change from one stage/agent to another one along the value chain.

Bialowolski (2014) examines factors influencing investment decision of companies in Poland. It is explained that there are two driving forces determine the investment decisions of polish companies, macroeconomic factors and law-related factors. For agricultural sector, the most important factors for the investment decision are found legal barriers, tax policies and trust in institutions.

Sarma, P. K., (2019) investigate the Value Chain analysis of tomato in Bangladesh. And Value creation, creating profits and productivity has been investigated in each agent level. Farmers have more than 43% of total value creations and the other agent (Collectors, wholesalers, retailers etc) have 57%.

The research findings show that the analysis of Value chain on groundnut in Ghana; distributer benefits most from oil and paste chain with 116% increase in profit. Further estimates of return on investment indicate that, the distributer again benefits most along the value chain (Adjei, etal. 2017).

Value added creation is defined for the barley value chain in Ethiopia. The highest value (54%) is shared and added by the producers followed by malt factory from malt barlet value chain. The highest profit margin with respective value of 53,4% and 38,6% by farmers and malt factory and followed by primary cooperative (3,3%) and cooperative union (1,2%) (Kassaw, M. et. al., 2021).

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7. Synthesis of Value Chain Modelling Tools

This is the part of the evaluation process of the different guidelines on agri-food value chain analysis. Consequently, Value chain analysis concentrate on four different dimensions in broader approach. However, most of the guidelines run with some part of them in particular approach mainly with the Institutional/Functional and Economic/financial. In broader approach, four different dimensions; Institutional/Functional analysis, Economic/Financial analysis, Social analysis and Environmental analysis are given in following tables with their concentrated tools and outcomes.

7.1 Institutional/Functional Analysis

Institutional/Functional analysis provides a detailed profile of the industry structure through the identification, description and quantification in physical terms of the sequence of operations concerning commodity production, processing, marketing and final consumption. More specifically, it examines:

a) Technical operations required from primary production to final consumption
b) Inputs used and intermediate outputs produced at each stage of the chain
c) Economic agents involved at the different stages and related functions
d) Physical flows of the commodity among the different agents
e) Bottlenecks (e.g., inputs availability, logistical issues, etc,)

This is called as MAPPING in general others come behind of the MAPPING such as Governance Analysis, Demand & Supply Conditions, SWOT analysis and End Market analysis. Each one of them has some specific data produced (Table 7.1)

Table 7.1 Tools and Outcomes of Institutional/Functional Analysis

TOOLS	INDICATORS/OUTCOMES	Production Process-Up/Down Streams	Quality Controls	Price Transmission	Product Delivery Channels	Investment Planning	Cultivation And Consumption Pattern	Guidelines Referred
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	Core process, agents, marketing channels,product – information-money flows, volüme/share of product flows			Flows of product, marketing channels		Flows of inputs, Flows of products, marketing channels,	1)FAO (2013) 2) M4P (2008) 3)GFU (2008) 4)VCA4D (2018)
GOVERNANCE ANALYSIS	1) Matrix of rules and standards and regulations 2) Matrix of Regulations and Agents3) 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		Rules, standarts and regulations,quality standarts, certification and labelling			Rewards and sunctions, economic supports,		1)M4P (2008) 2)GFU (2008) 3)VCA4D (2018)
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			International and national prices-time series			Quantity of supply and demand for different type ofproducts	1)FAO (2013) 2)M4P (2008)
SWOT ANALYSİS	1) Strengths of VC 2) Weaknesses of VC 3) Opportunities of VC4) Threats of VC							Almost All Guideliness
END MARKET ANALYSIS	1) National market 2) International Market (Import-Export)							1)FAO (2013) 2)USAID (2008)

Sources: Authors' elaboration from guidelines reviewed

7.2 Economic/Financial Analysis

The "Economic Analysis" of a value chain assesses in quantitative terms the creation of "Value Added" and its distribution to the various agents involved. The Value Added is a measure of wealth created in an economic system by a production process, net of the resources consumed by the process itself. More specifically, the economic analysis allows the analyst to determine:

a) The value added created by the overall value chain
b) The value added and margins for each economic agent at each stage of the chain
c) The allocation of value added among production factors (capital labor, other assets) and the public budget, through the respective distributive variables: (profits, wages, rents and taxes)
d) Data provision for investment planning.

Financial analysis can be ensured by the value-added data resulted. Another tool is to prepare a Policy Analyze Matrix (PAM). The fourth tool (End Market Analysis) which is very important part of the VC analysis contains some explanatory data on Consumer behavior (Table 7.2).

Table 7.2 Tools and Outcomes of Economic/Financial Analysis

TOOLS	INDICATORS/OUTCOMES	Investment Planning	Cultivation and Consumption Patterns	Guidelines Referred
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	Net Value added		1)FAO (2013) 2)M4P (2008) 3)VCA4D (2018)
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	Cost-Benefit, NPV, IRR, Payback period,break-even point		1)FAO (2013) 2)M4P (2008) 3)VCA4D(2018)
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)			1)FAO (2013)
END MARKET ANALYSIS (Psychographic Analysis of Farmers/Consumers/Phase 2)	1) Value 2) Attitude 3) Behavior 4) Preferences		Willingnessto pay, willigness to accept	1) USAID (2008)

Sources: Authors' elaboration from guidelines reviewed

7.3 Social Analysis

Social analysis of the value chain consists of the Contribution of the value chain to the socio-economic situation, including income, expenditure and other social wellbeing implications for various social groups of interest to the value chain. Geographic location of the value chain and implications for territorial set-up and development (rural-urban relationships, synergies with other activities, role in local production systems etc.). This analysis consists of the elements of Employment Creation, Gender analysis and gender equality and decent work deficit evaluation (Table 7.3).

Table 7.3 Tools and Outcomes of Social Analysis

TOOLS	INDICATORS/OUTCOMES	Social Inclusiveness	Guidelines referred
EMPLOYMENT CREATED	1)Labor needs by agents-activities-process 2)Wage differentiation 3)Labor intensity: number of persons employed in various VC stages		1)M4P (2008) 2)ILO (2021) 3)VCA4D (2018)
GENDER ANALYSIS	1) Women and Young participation 2) Number of persons (M/F) employed in the value chain (sector) andtrends	Young- women participation	1)M4P (2008) 2)ILO (2021) 3)VCA4D (2018)
DECENT WORK DEFICITANALYSIS	1) List and level of health and safety risks. Incidence of occupational accidents in the workplace; working time lost due to sickness; worker perceptions of physical and mental well-being. 2) Job security and safety: type of employment (contractual status, legalbenefits of the contracts, duration of contracts); presence of precariousconditions; presence of additional disadvantages due to gender, ethnicity, or race.	Health and safety conditionin labor market	1)ILO (2021)

Sources: Authors' elaboration from guidelines reviewed

7.4 Environmental Analysis: Impacts on Biodiversity, Human Health, Resource Deplation, Ecosystem Quality

Environmental analysis is the backbone of the BIOVALUE Project which has a special attention in this part affecting biodiversity along the value chain. The result of the environmental analysis of the VC is to prove augmentation or not of biodiversity. The evaluation of the environmental side of the VC is made by Hot Spot Analysis, Environmental Assessment and Life Cycle Assessment (Table 7.4).

Table 7.4 Tools and Outcomes of Environmental Analysis

TOOLS	INDICATORS/OUTCOMES	Biodiversity, Human health, Resource Depletion, Ecosystem Quality	Guidelines referred
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	Augment or notaugment the biodiversity	1)GTZ/GIS (2015)
ENVIRONMENTAL ASSESSMENT	1) Resource depletion 2) Ecosystem quality 3) Human health 4) Biodiversity loss	Augment or not augment the biodiversit	1)FAO (2014)
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) Ionising radiation, human health 15) Particulate matter emissions	Augment or not augment thebiodiversity	1)VCA4D (2018)

Sources: Authors' elaboration from guidelines reviewed

8. An Evaluation on Case Studies Review of Agri-Food Value Chain and Their Related Tools

This part is prepared to guide the other WPs on agri-food value chain analysis which will be run in the next project' stages. Existing Value chain modelling tools directly or with some modifications according to project objectives will be used in field studies on value chain analysis of BioValue crops. This part helps us to understand the methodological concentration, neglected side and the methods generally used in agro-food value chain analysis.

8.1 The List of Case Studies Product Based and Regional Based VCs

Case study survey has been done by the partners which is given in the section 1 (See Table 1.2). 204 case studies have been surveyed according to the structured questionnaire for investigating the VC tools and their related indicators. The case studies are given in Figure 8.1 between 2000 and 2022. It has been seen that most of the studies were done last five years in agro-food value chain analysis.

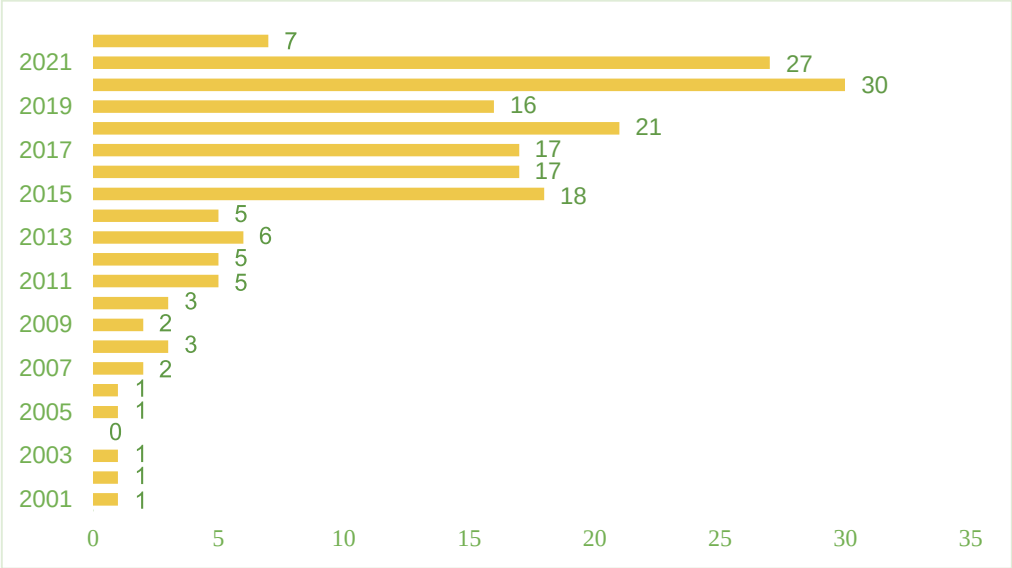

Figure 8.1 Case Studies by Years

Table 8.1 shows the information that are studied in Cases of Value Chain Analysis by reviewing the databases. The reviewed cases have been done by the different researchers for the different product groups and regions. It can be said that most of the case studies on Agri-food Value chain analysis has been studied mainly for African and East Asian countries.

Table 8.1 List of the Value Chain by Products and Regions

Key Study Country	Product Group	Key Study Country	Product Group
India	Tubers	Guyana	Fruit And Permanent Crops
Zimbabwe	Tubers	Indonesia	Oily Crops
Italy	Tubers	Ghana	Tubers
Italy	Fruit And Permanent Crops	Ghana	Tubers
Bangladesh	Cereals	Serbia	Cereals
West Africa	Cereals	Italy, Emilia Romagna Region	Cereals
Uganda	Cereals	UK, France	Cereals
Tanzania	Cereals	Africa and Southeast Asia	Legumes
Uganda	Cereals	Ethiopia	Cereals
Bangladesh, China, India, And Vietnam	Cereals	Indonesia	Oily Crops
Tanzania	Cereals	Indonesia	Oily Crops
Tanzania	Cereals	Ghana	Fruit And Permanent Crops
Kenya	Cereals	Malawi	Tubers
Ethiopia	Cereals	Ethiopia	Tubers
Burkina Faso	Cereals	Italy	Cereals
Malawi And Mozambique	Cereals	India	Cereals
Iraq	Cereals	Denmark	Cereals
Iraq	Fruit And Permanent Crops	Finland	Cereals
Iraq	Vegetables	Finland	Cereals
Iraq	Fruit And Permanent Crops	World	Cereals
Bangladesh	Vegetables	Scotland	Cereals
Italy, French, Switzerland, Denmark	Legumes	France	Cereals
Malawi	Legumes	France	Legumes
Sri Lanka	Legumes	Four Regions of Uganda (Apac and Oyam in The North; Kapchorwa and Pallisa in The East; Kibaale in The West; Plus Kabale in South-Western Uganda)	Legumes
Ethiopia, Myanmar, Nigeria, Uganda, Tanzania	Legumes	Papua New Guinea	Fruit And Permanent Crops
Nigeria	Tubers	Ethiopia	Fruit And Permanent Crops
Ghana	Cereals	Nepal	Fruit And Permanent Crops
Mekong Delta Area	Cereals	Georgia	Fruit And Permanent Crops
Thailand	Cereals	Tanzania	Fruit And Permanent Crops
Tanzania	Cereals	China	Fruit And Permanent Crops
Ghana	Cereals	Pakistan	Fruit And Permanent Crops
Malaysia	Cereals	Jordan	Oily Crops
Nigeria	Cereals	Portugal	Fruit And Permanent Crops
Kenya	Cereals	Tunisia	Oily Crops
Thailand	Cereals	Turkey	Oily Crops
Senegal	Cereals	Greece	Fruit And Permanent Crops
Italy	Cereals	China	Fruit And Permanent Crops
Burkina Faso, Ghana, Mali, Nigeria, Ethiopia, Tanzania, And Uganda	Cereals	Greece	Fruit And Permanent Crops
Tanzania	Cereals	Greece	Fruit And Permanent Crops
India	Legumes	Turkey	Vegetables
Bangladesh	Cereals	Tanzania	Fruit And Permanent Crops
Ethiopia	Cereals	Mexico	Fruit And Permanent Crops
Indonesia	Cereals	Italy	Fruit And Permanent Crops
Myanmar	Cereals	India	Fruit And Permanent Crops
Nigeria	Cereals	Uganda	Vegetables
Mozambique	Cereals	Germany	Oily Crops
Ghana	Cereals	Germany	Vegetables
Nigeria	Cereals	Italy	Vegetables
Benin	Cereals	Tanzania	Vegetables
Zambia	Cereals	Uganda	Fruit And Permanent Crops
India	Cereals	Indonesia	Vegetables
India	Cereals	Cameroon	Vegetables
Flanders	Cereals	Sri Lanka	Fruit And Permanent Crops
Nigeria	Cereals	Nepal	Vegetables
Ethiopia	Cereals	Indonesia	Vegetables

Table 8.1 List of the Value Chain by Products and Regions (Continue)

Key Study Country	Product Group	Key Study Country	Product Group
USA	Vegetables	Uganda	Fruit And Permanent Crops
Algeria	Fruit And Permanent Crops	Italy	Fruit And Permanent Crops
India	Fruit And Permanent Crops	Malawi and Mozambique	Vegetables
Sri Lanka and Australia	Legumes	Indonesia	Vegetables
Philippines	Vegetables	Nepal	Vegetables
India	Vegetables	Nepal	Vegetables
Nepal	Tubers	Georgia	Vegetables
Ethiopia	Tubers	Ethiopia	Fruit And Permanent Crops
Kenya	Tubers	Ethiopia	Fruit And Permanent Crops
Ethiopia	Vegetables	Ethiopia	Fruit And Permanent Crops
Ethiopia	Vegetables	Ethiopia	Fruit And Permanent Crops
Bangladesh	Vegetables	Cameroon; Cote d'Ivoire, Guinea, Mali, Ghana, Nigeria	Fruit And Permanent Crops
Philippines	Cereals	South Africa	Fruit And Permanent Crops
Philippines	Legumes	Afghanistan	Fruit And Permanent Crops
Guatemala	Vegetables	Peru	Fruit And Permanent Crops
Bangladesh	Vegetables	Italy	Fruit And Permanent Crops
Malawi and Mozambique	Vegetables	Switzerland	Cereals
UK	Cereals	Georgia	Fruit And Permanent Crops
India	Fruit And Permanent Crops	Tunisia	Oily Crops
India	Fruit And Permanent Crops	Germany	Cereals
Nepal	Vegetables	Georgia	Vegetables
Indonesia	Fruit And Permanent Crops	Georgia, Armenia, Azerbaijan	Vegetables
Nepal	Vegetables	İnternational	Cereals
North Atlantic Region	Cereals	Georgia	Fruit And Permanent Crops
Ethiopia	Cereals	Germany	Fruit And Permanent Crops
Bangladesh	Cereals	Germany	Fruit And Permanent Crops
Ethiopia	Cereals	São Tomé E Príncipe	Vegetables
Pakistan	Cereals	Ethiopia, Mareko District	Vegetables
Germany	Cereals	Ethiopia, Abeshge District	Vegetables
Vietnam	Fruit And Permanent Crops	Dominica	Vegetables
Croatia	Fruit And Permanent Crops	Ethiopia	Vegetables
Kenya	Legumes	Moldova	Vegetables
Darling Downs - Southern Queensland (Australia)	Legumes	Bangladesh	Vegetables
Afghanistan	Fruit And Permanent Crops	Peru	Fruit And Permanent Crops
India	Fruit And Permanent Crops	Bangladesh	Vegetables
Sub-Saharan Africa	Legumes	USA	Vegetables
Brazil	Oily Crops	India	Fruit And Permanent Crops
Indonesia	Oily Crops	Ethiopia	Fruit And Permanent Crops
Colombia	Fruit And Permanent Crops	Worldwide	Fruit And Permanent Crops
Madagascar	Fruit And Permanent Crops	Vietnam	Fruit And Permanent Crops
Colombia	Tubers	Rwanda	Fruit And Permanent Crops
India	Fruit And Permanent Crops	Germany	Cereals
Ghana	Cereals	Kenya	Vegetables
South Africa	Legumes	Germany	Vegetables
France	Cereals	Germany	Vegetables
Germany, Italy, Croatia, Denmark, Portugal, Hungary, and Scotland	Legumes	Indonesia	Vegetables
France, Denmark, Italy, Lithuania, UK, CR, Germany, Switzerland, Poland, Estonia, Greece, Ireland, Belgium, Finland	Legumes	Mali	Cereals

8.2 The Results of the Case Studies' Survey on Agri-food Value Chain Tools and Their Related Indicators

The review results show that Cereals, Vegetables and Fruits are the product groups in which they are mostly interested the different researchers/institutions. Legumes, tubers and oily crops comes behind them (Figure 8.2).

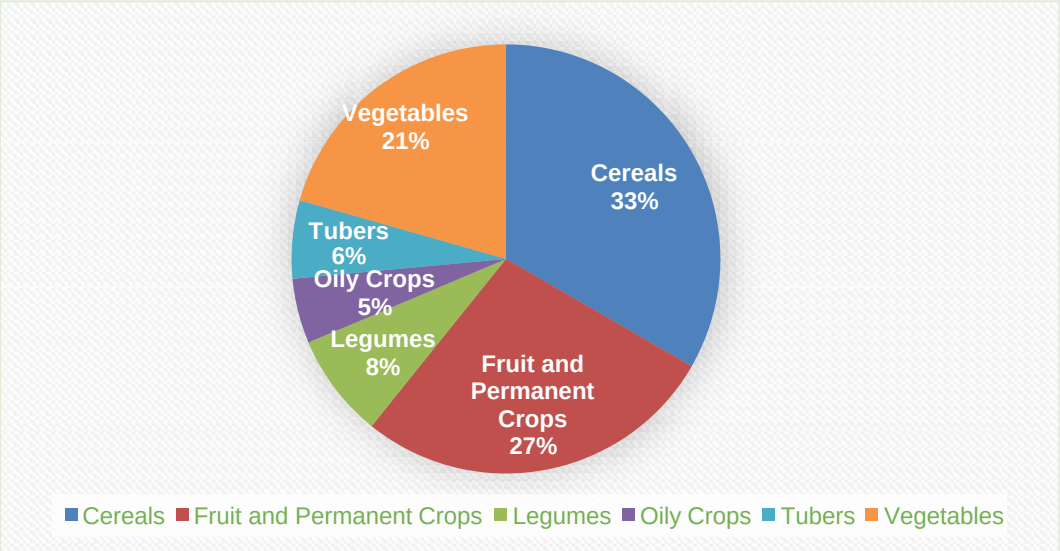

Figure 8.2 Group of Products Investigated in The Case Studies Surveyed

The researchers generally have studied activity and agent-based approach, together in the same case while agent base approach was used more than the activity-based approach (Figure 8.3).

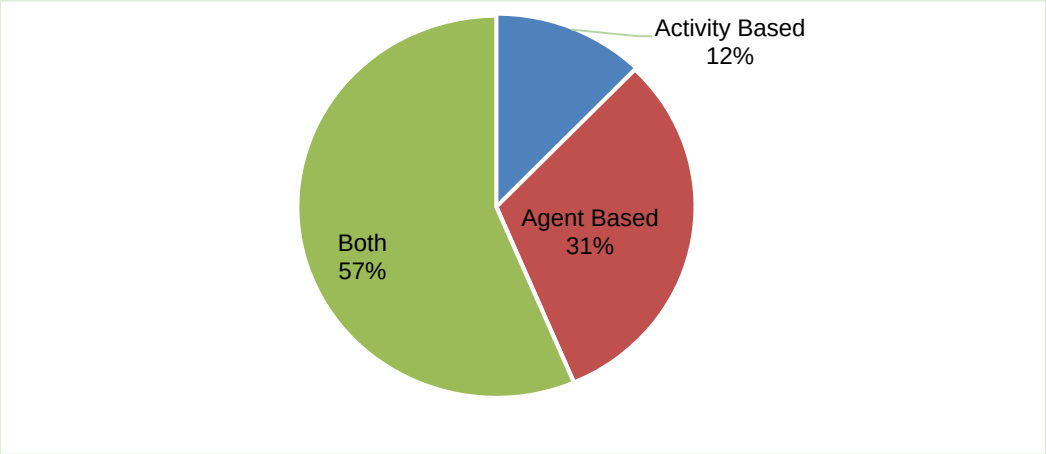

Figure 8.3 Agent and Activity Based Approaches in the Case Studies Surveyed

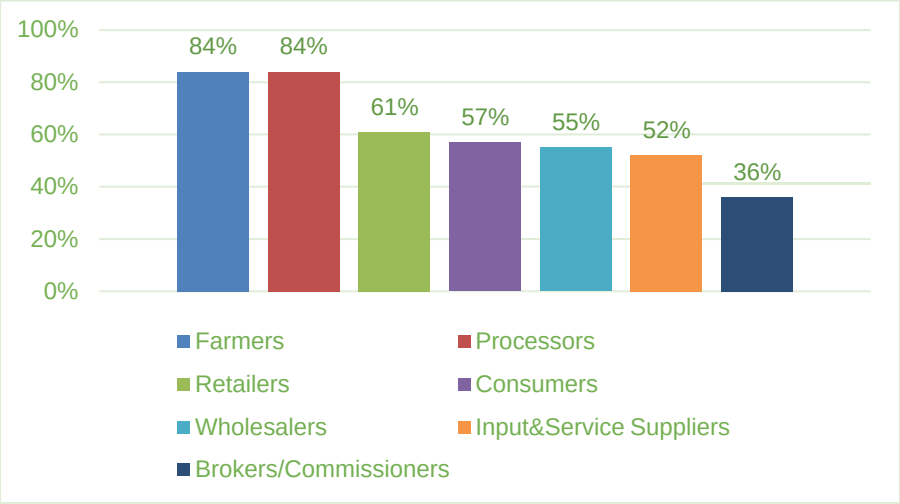

Figure 8.4 Investigated Agents in The Case Studies

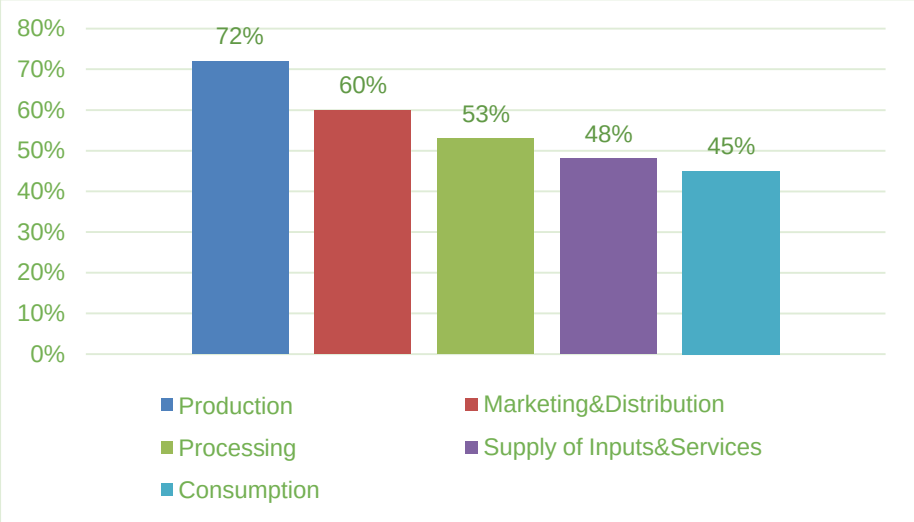

Figure 8.5 Investigated Activities in The Case Studies

Figures 8.4 and 8.5 demonstrate the investigated agents and activities in the surveyed Case Studies on the Value Chain analysis. Most of the agents have been included which are generally existent in the agri-food Value Chains with the various importance. The main activities are also included in the agro-food value chain analysis as much as expected; 1) Production, 2) Marketing & Distribution, 3) Processing, 4) Supply of Inputs & Services and 5) Consumption.

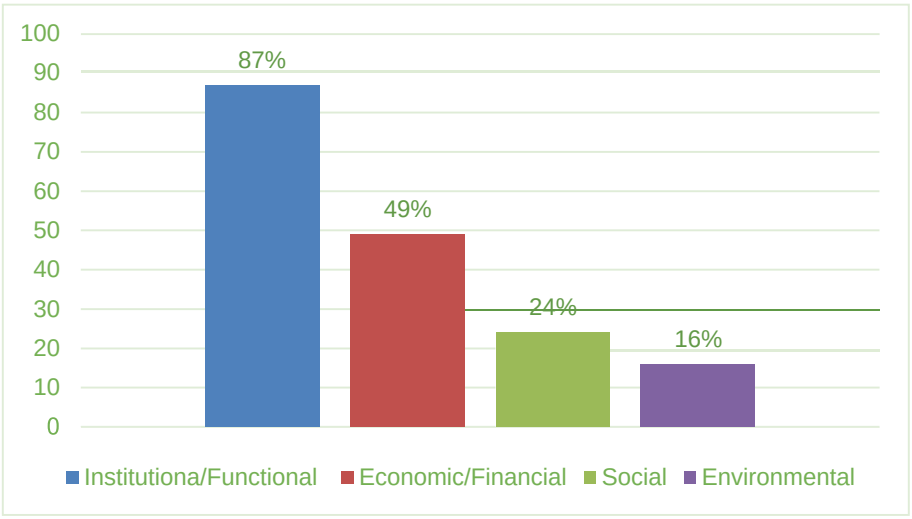

Figure 8.6 The Area of Interest in Case Studies Surveyed

Figure 8.6 indicates that the area of interest studied by the researchers on Institutional/Functional- Economic/Financial-Social-Environmental analysis. The researchers mainly have studied on Institutional/Functional analysis which is the first step of Value Chain analysis. The other most studied area of interest is Economic/Financial analysis of Value Chain. Social and Environmental side of the Value Chain have been studied with a lesser attention.

8.2.1 The Results on Institutional/Functional Analysis' Tools and Indicators

Figure 8.7 indicates the VC Institutional/Functional Tools included in the case studies surveyed. It is very clear that researchers have generally used Mapping of the Value Chain as it is an important area of interest for the Value Chain analysis. The other tools are Demand & Supply analysis, Governance analysis and End Market analysis (phase 1-Export/Import condition) of Value Chains.

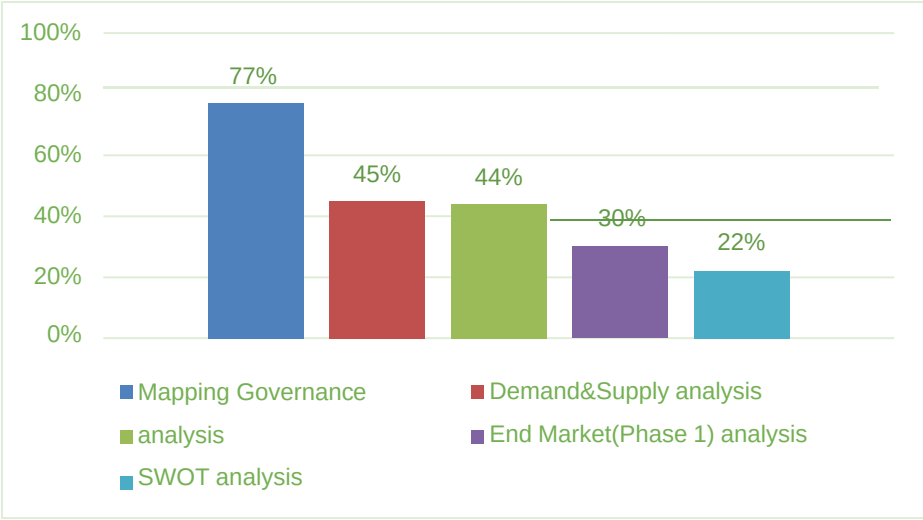

Figure 8.7 Institutional/Functional Analysis' Tools in Value Chains by Case Studies Surveyed

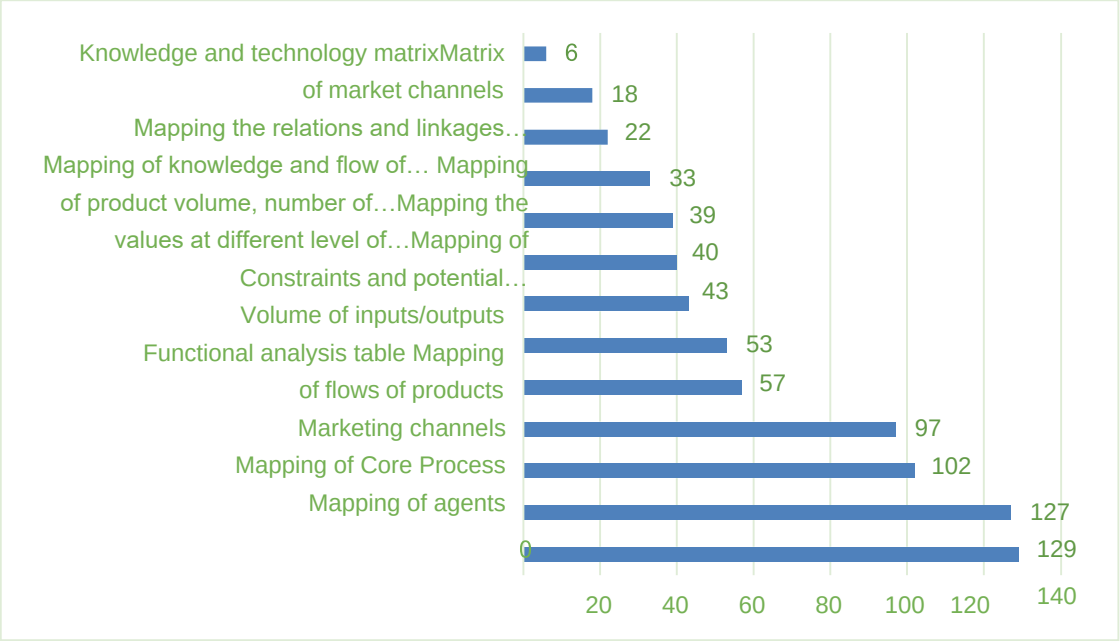

Figure 8.8 The number of Cases in Which the Indicators/Outcomes of Mapping Studied

Figure 8.9 The number of Cases in Which the Indicators/Outcomes of Governance Studied

Figure 8.10 The number of Cases in Which the Indicators/Outcomes of Demand&Supply Conditions Studied

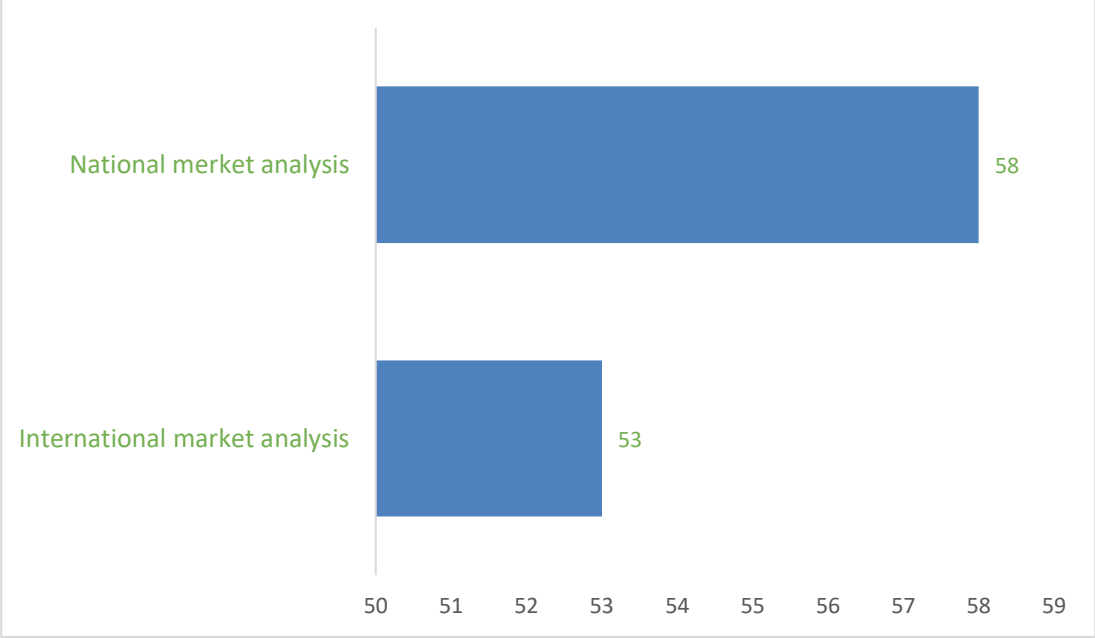

Figure 8.11 The number of Cases in Which the Indicators/Outcomes of End Market Analysis (Phase-1) Studied

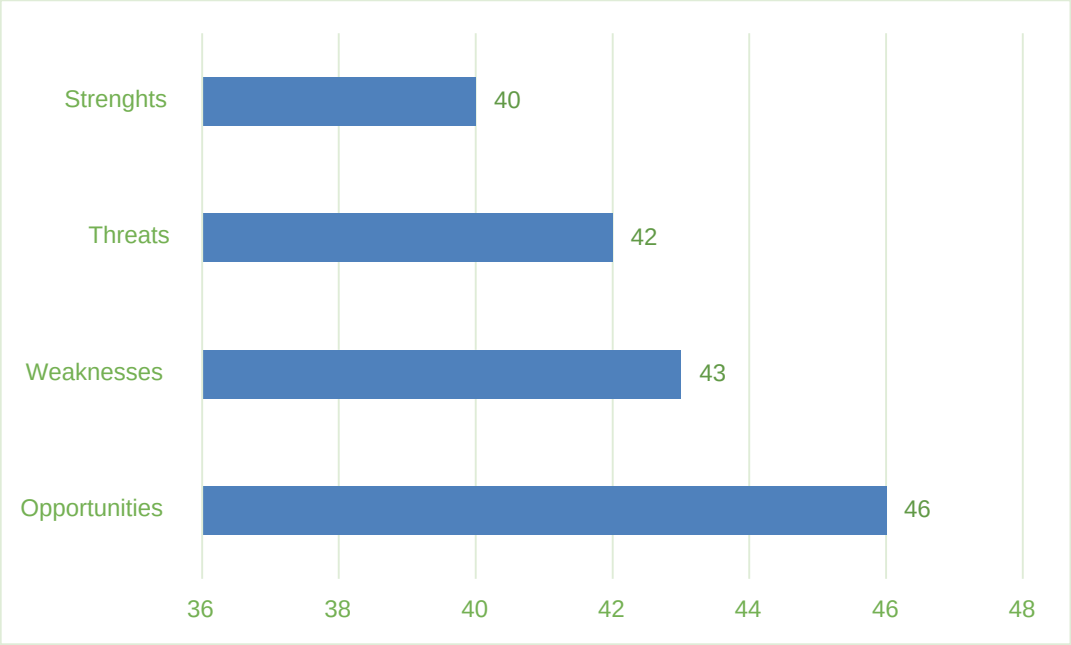

Figure 8.12 The number of Cases in Which the Indicators/Outcomes of SWOT Analysis Studied

Figures from 8.8 to 8.11 show the indicators/outcomes included in each Value Chain Tool. The most widely used Indicators of MAPPING are: 1) Mapping of Agents 2) Mapping of Core process (Activities) 3) Marketing channels and 4) Flows of Products. For the GOVERNANCE analysis, the researchers have generally used 1) The list of constraints, 2) Quality standards and 3) Rules & Regulations & Accession to market, technology and finance as a sort of indicators/outcomes. The DEMAND and SUPPLY conditions of the product have been investigated with the statistical data on: 1) Area sown, Yields, number of farmers, etc., 2) Export and Import statistics and 3) Prices of national and International level. The END MARKET analysis has been researched with the data of national and international market analysis. The last toll is SWOT analysis knows a general tool which is widely used for the Value Chain analysis with the well-known indicators of S-W-O-T (Figure 8.12).

8.2.2 The Results on Economic/Financial Analysis' Tools and Indicators

Figure 8.13 shows the VC's Economic/financial Tools included in the case studies surveyed. Value Added analysis is a top research area in the economical side of the Value Chain Analysis. Consumer behavior and Financial analysis are also included in the case studies although they have some relatively minor importance.

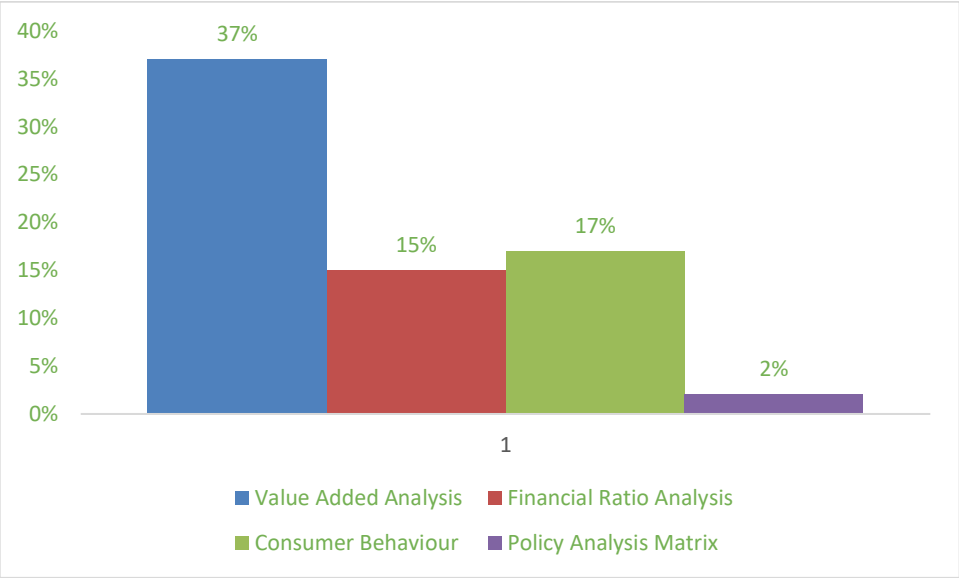

Figure 8.13 Economic/Financial Analysis' Tools in Value Chains by Case Studies Surveyed

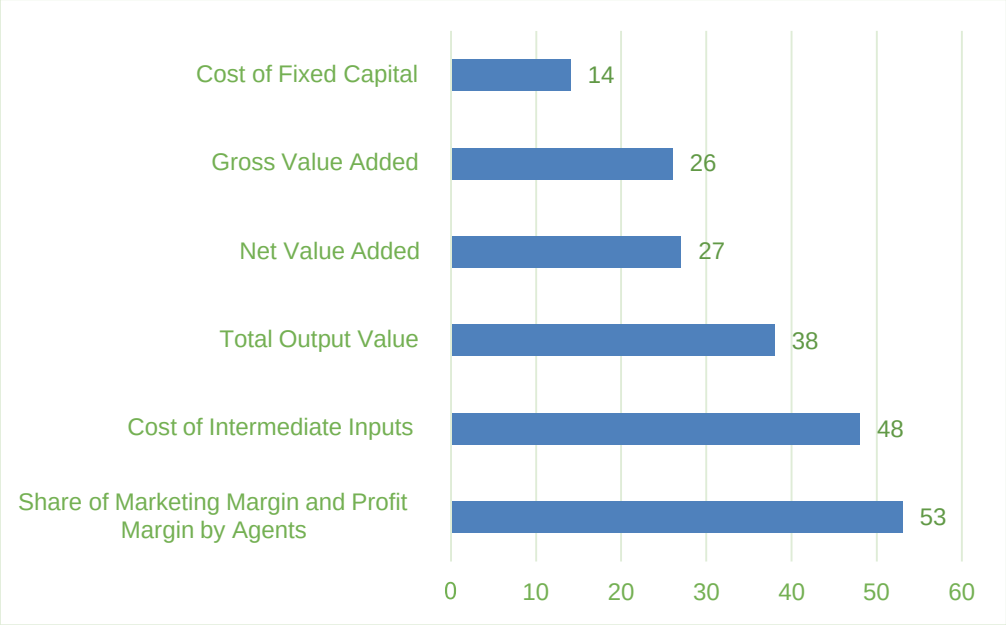

Figure 8.14 The Number of Cases in which The Indicators/Outcomes of Value-Added Studied Analysis

Value Added analysis consists generally of: 1) The share of marketing and profit margin by agents, 2) Cost of intermediate inputs, 3) Total output value, 4) Net Value Added, 5) Gross Value Added and 5) Cost of Fixed capital, respectively (Figure 8.14).

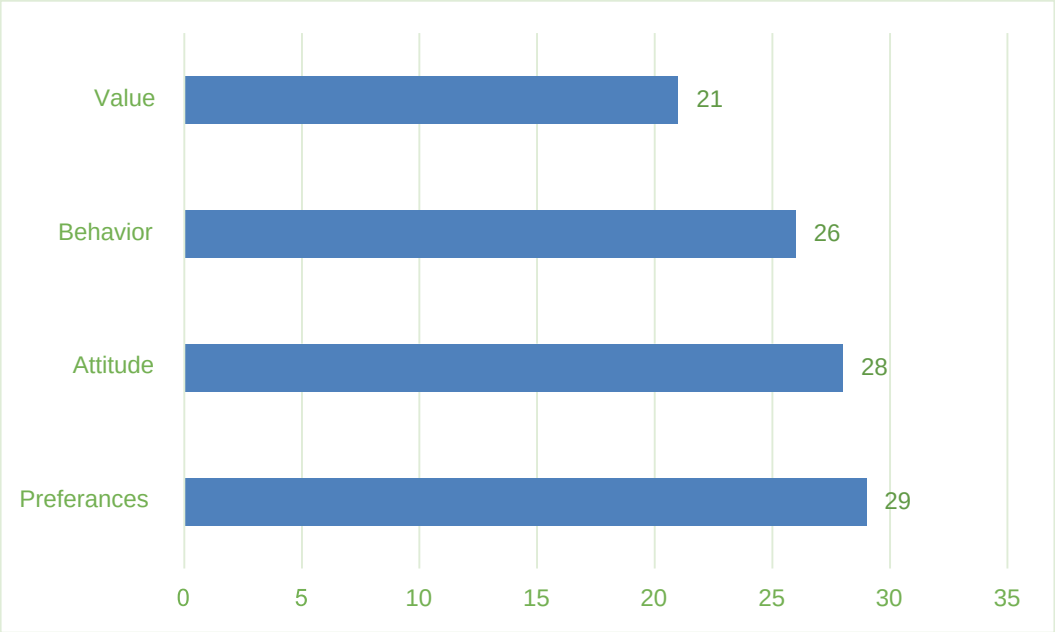

Figure 8.15 The Number of Cases in Which The Indicators/Outcomes of the Consumer Behaviour Analysis Studied

The research on Consumer behavior of the Value Chain has been focused on: 1) Preferences of the consumers, 2) Attitude, 3) Behavior and 4) Value of the consumers, respectively (Figure 8.15).

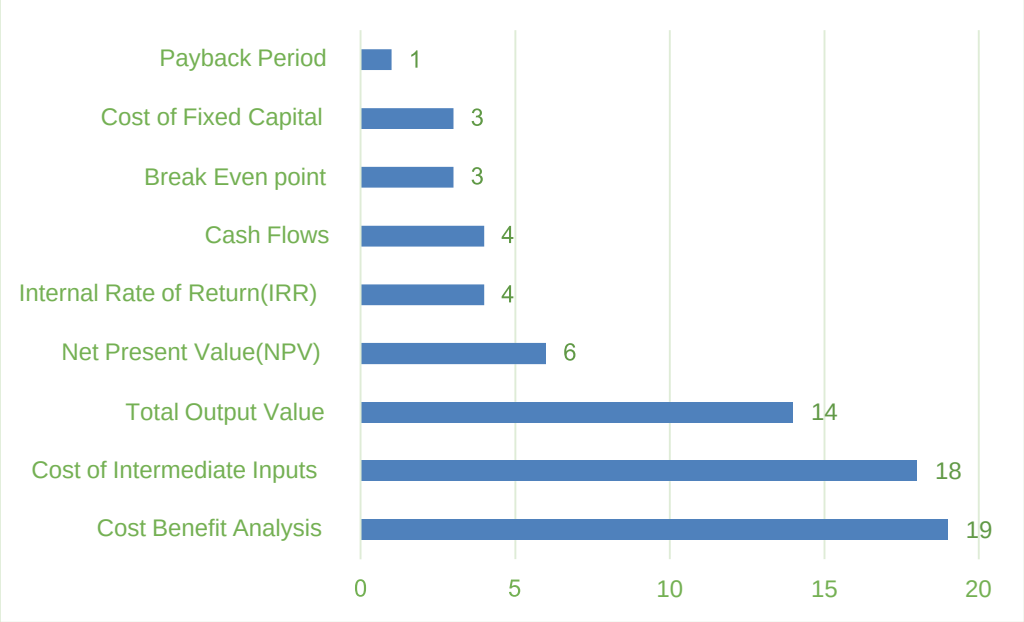

Figure 8.16 The Number of Cases in Which The Indicators/Outcomes of the Financial Ratio Analysis Used

Financial ratio analysis has been done at 15% of the surveyed case studies. Hence, the related indicators haven't been studied as it is expected. 19 of cases have Cost Benefit analysis, 18, 14, 6, 4 and only 3 of 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 in Figure 8.16.

Policy Analysis Matrix (PAM) is included only 4 case studies (2%)and its indicators are Domestic Resource cost, Private cost ratio, Private Value-Added ratio and Social Value Added ratio. Nonetheless, the utilization of them in the Value Chain Analysis is relatively very restricted (Figure 8.17).

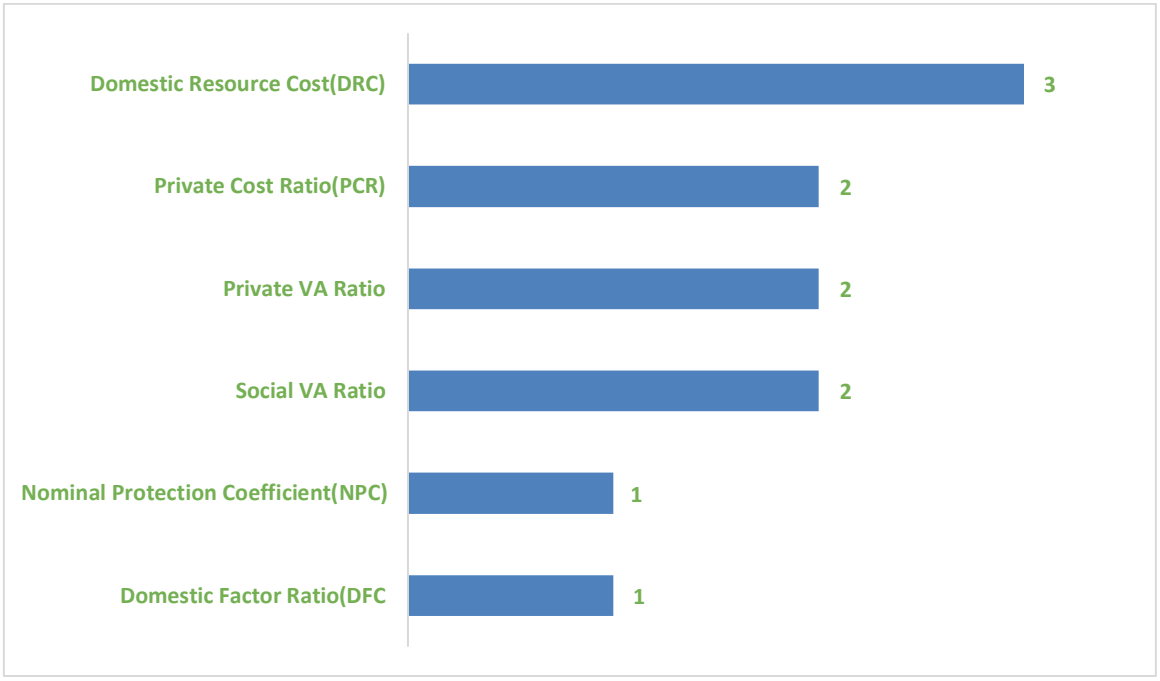

Figure 8.17 The Number of Cases in Which Indicators/Outcomes of Policy Analysis Matrix

8.2.3 The Results on Social Analysis' Tools and Indicators

Social analysis of value chain is an important issue which covers people with social inclusion on the base of different gender and age group of people. It also includes how much employment is created with the decent working conditions (Figure 8.18) Although the number of cases which include the social analysis have a minor attention. Gender analysis is divided in two different areas of research which they are concentrated on Women & Youth participation in Value Chain. Generated employment level is an important issue which is relative to growth. A Value chain should attempt to create new job opportunities as much as it can (See Figure 8.19-8.20-8.21).

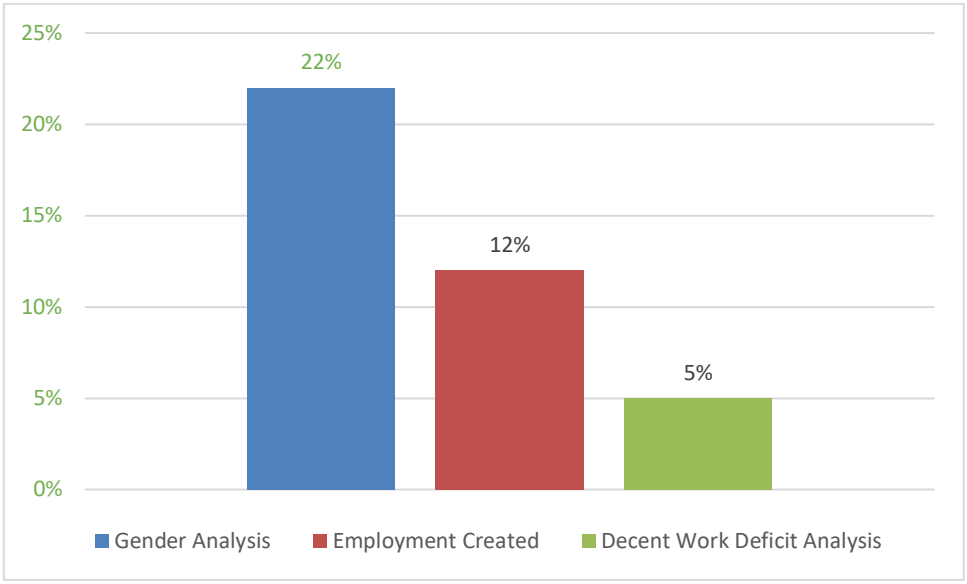

Figure 8.18 Social Analysis' Tools in Value Chains by Case Studies Surveyed

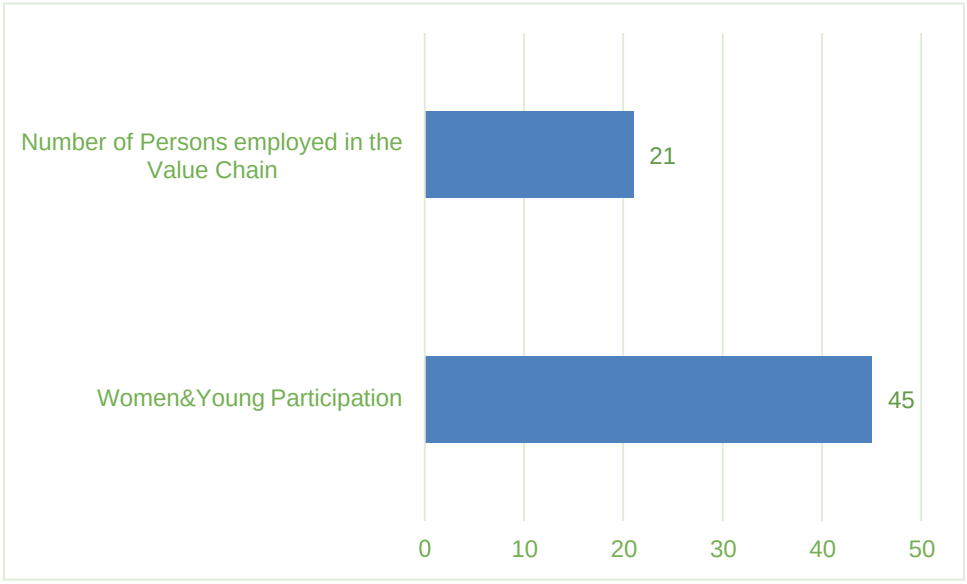

Figure 8.19 The Number of Cases in Which the Indicators/Outcomes of Gender Analysis Studied

Figure 8.20 The Number of Cases in Which the Indicators/Outcomes of Employment Creation Analysis

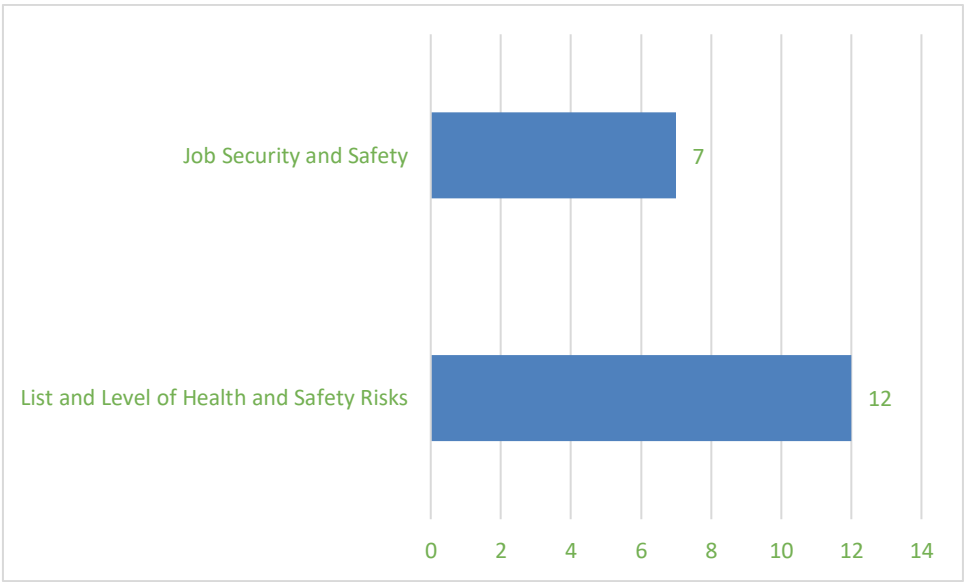

Figure 8.21 The Number of Cases in Which the Indicators/Outcomes of Decent Work Deficit Analysis

8.2.4 The Results on Environmental Analysis' Tools and Indicators

Environmental analysis tries to evaluate the environmental effects of the value chain which explains the effects on human health, resource depletion and ecosystem quality mainly resulting in the biodiversity decline. Environmental analysis of value chains has been done by using different ways and approaches such as Hot spot analysis, Environmental Assessment and Life Cycle assessment. Hot spot analysis is an analysis which has qualitative data, and the others are subjected to quantitative data analysis. It is noted that environmental analysis has some limited attention by the researchers and hot spot analysis is being preferred more (Figure 8.22).

The main objective of the Hot Spot Analysis is to identify key impacts along the entire value chain. Environmental and social impacts of each life cycle phase and their interrelations are identified as well as the overall impact level of different social and environmental categories. The environmental and social "peaks" identified are defined as hot spots (Rohn, H., et al. 2014).

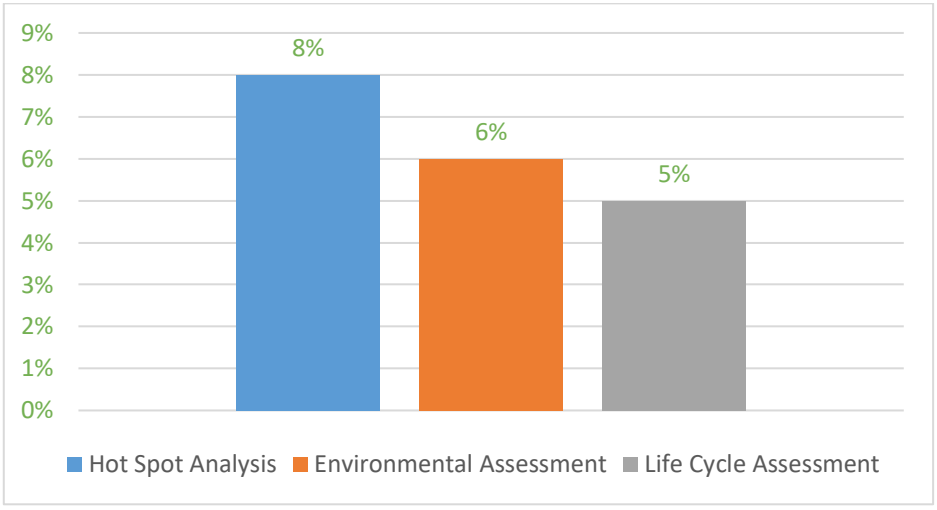

Figure 8.22 The Cases Detected in Which The Tools Used for The Environmental Analysis

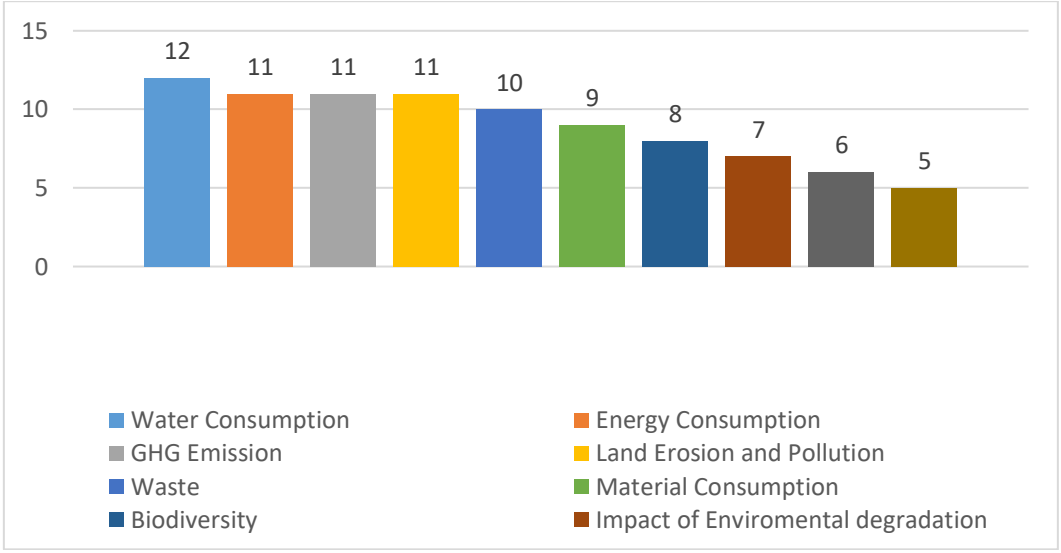

Figure 8.23 The Number of Cases in Which The Indicators Used for The Hot Spot Analysis

The case studies are mainly concentrated on Water consumption, energy consumption, GHG emission, Land erosion and pollution and the rest of them follow while the effect on biodiversity is researched in 8 cases (Figure 8.23).

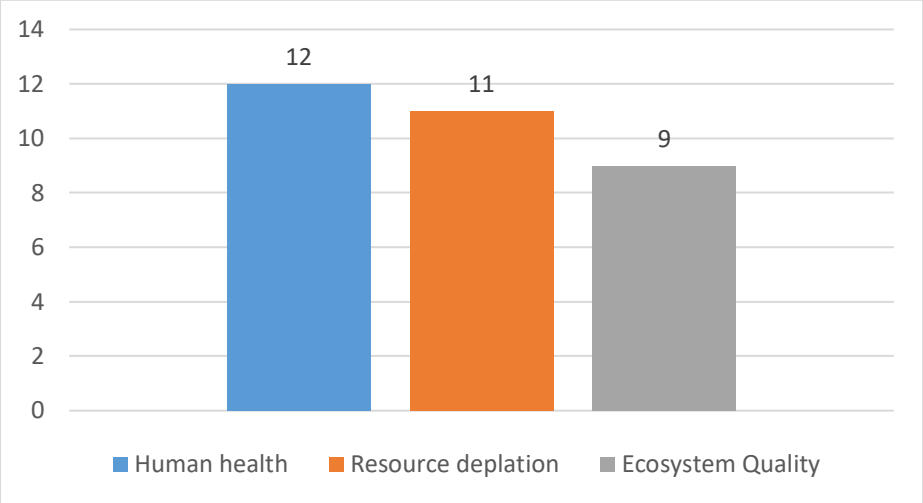

Figure 8.24 The Number of Cases in Which The Indicators Used for The Environmental Assessment

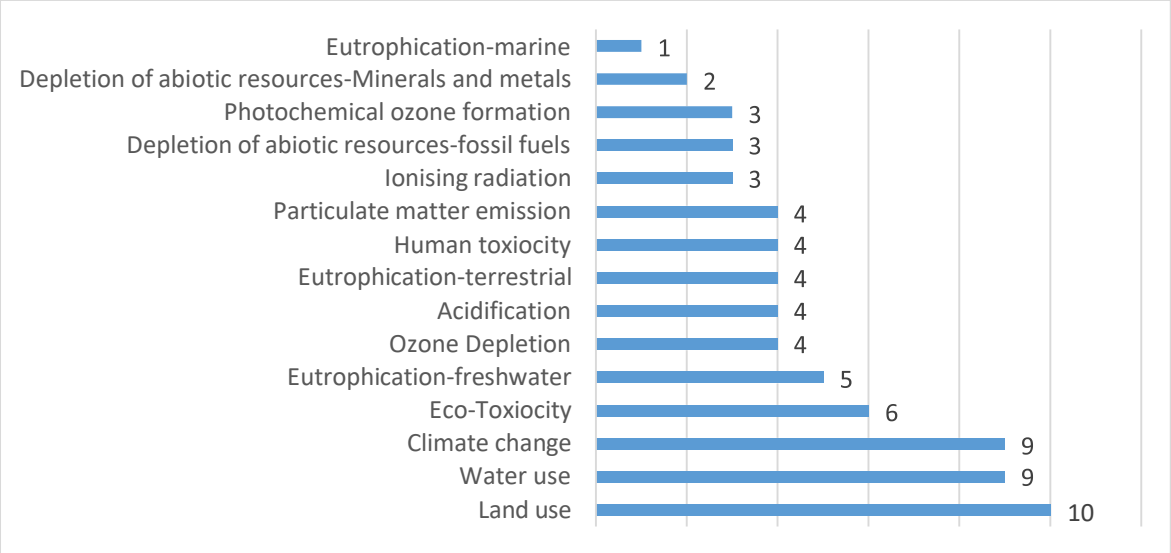

Figure 8.25 The Number of Cases in Which The Indicators Used for The Life Cycle Assessment

Environmental assessment and Life Cycle assessment are more comprehensive analysis approaches but need to use some specific software with their quantitative data as each approach has different indicators. Environmental asssessment analyses the human health, resource depletion, ecosystem quality and Life cycle assessment analyses different ecological data such as depletion, toxicity, acidifications, climate change data and so on (Figure 8.24, Figure 8.25).

Reference List of Section 8

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9. Conclusion and Inputs for The Other WPs

In Task 2.1. of this WP2, the literature review tries to ensure that the conceptual and analytical framework is up to date. All kind of information sources such as research reports, web-based information, product based and regional based research results have been analysed to generalize up-stream and down-stream of value chains with a list of some agri-food value-chains. Such a review included databases and tools modelling the production processes, investment planning, quality control, price transmission and product delivery channels. It is also included a review of the causes and conditions that the consumption and cultivation of numerous crops (legumes, vegetables) were altered or completely eliminated over the course of time. In addition, based on relevant data provided some additional input on the pathways through which biodiversity has declined in the modern food value chain and possibly highlight some factors that could be relevant for increasing biodiversity in the future.

In order to identify and review the concept of "agri-food value chain tools" we initiated firstly with the theoretical background including some important widely used Guidelines-FAO, UNIDO, USAID, ILO, GTZ and some others- of Value Chain Analysis and then deeper analysis was executed by searching the scientific databases SCOPUS, WEB OF SCIENCE and EBSCO. 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 since each one has some specific objectives. This is called as a guideline-based review.

The second attempt was concentrated on the testing of the tools investigated in the case study survey. This would be an optimal approach to achieve Milestone MS4 "Selected and Tested Value Chain Tools Suitable for agri-food value chain".

The reviewed guidelines show that Value chain analysis can be run into the four-dimensional approach. Of course, these are mostly depending on the guidelines' objectives, but these are varying generally on Institutional/Functional and Economic/financial analysis of Value chains. A minority of them can observe the activities on the base of social and environmental awareness. Hence, this text follows an approach with the four dimensions of the Value Chain analysis; 1) Institutional/Functional, 2) Economic/Financial, 3) Social and 4) Environmental evaluation.

Institutional/Functional analysis provides a detailed profile of the industry structure through the identification, description and quantification in physical terms of the sequence of operations concerning commodity production, processing, marketing and final consumption. The Institutional/functional analysis aims to build an overall description of the value chain system. It identifies and characterises the main actors and stakeholders involved and expands on some of the main strategic development challenges faced. This analysis can produce important data on production process, up-down-streams, product delivery channels, quality control schemes as they are requested in the Task 2.1. The main tool of this analysis is MAPPING which is the first step of the analysis start. The other sides of the Institutional/Functional analysis are Governance analysis, Demand and Supply analysis, SWOT analysis, end market analysis. Institutional/functional analysis of the value chain also produces data on Production process and Up and down-streams of value chain, the data on quality control schemes, Price transmission, Product delivery channels, Cultivation and consumption patterns of the value chains.

The economic/financial analysis aims at measuring and interpreting the profitability and sustainability of the value chain operations for all the actors directly involved. Its purpose is to

inform on the economic effects of the value chain within the national economy in terms of growth generation and distribution of incomes. It also assesses its competitiveness and viability within the global economy. So, this kind of analysis uses the data on monetary and the data equivalent monetary in general. This analysis can produce important data on investment planning to be foreseen and the data on farmers' and consumers' psychographic analysis with their value, attitude, behaviour, preferences.

Social analysis is concentrated on two dimensions. First is the social inclusiveness of the value chain. In this part of the analysis how the VC organisation and governance involve the various stakeholders and how the incomes and employment generated are distributed among social groups. The value chain has some specific impacts on vulnerable groups such as subsistence-oriented farmers, smallholders, women, youth, and marginalised people (landless rural workers, minority communities). And second one is social sustainability. The analysis of social sustainability focuses on assessing established and potential consequences of the VC operations in an array of six domains of importance for decision makers because they convey key concerns of development: Working Conditions, Land and Water Rights, Gender Equality, Food and Nutrition Security, Social Capital, and Living Conditions.

Environmental analysis of value chain mainly relates with the "Resource depletion", "Ecosystem quality", "Human health", "Climate change and "Biodiversity". By combining data and findings on the various areas related with the topics above, qualitative and quantitative appraisal has to be done for the environmental sustainability of the value chain. The approach to evaluate the environmental sustainability of the value chain is based on the quantitative Life Cycle Assessment (LCA) accompanied by an exploratory assessment of biodiversity risks.

The case study review is a part of the deliverable to analyse the evidence in order to see the value chains and their concentrated tools and indicators which are generally used. More than 200 case studies have been surveyed. The reviewed cases have been examined by different researchers of the consortium for the different product groups and regions. It can be said that the majority of the case studies on Agri-food Value chain analysis has been studied mainly for African and East Asian countries.

The review results indicate that Cereals, Vegetables and Fruits are the product groups in which the different researchers/institutions are most interested in and legumes, tubers and oily crops come behind them. The researchers generally have studied activity and agent-based approach, together in the same case with the agent-base approach being the most preferable one. The most of the agents have been included which are generally exist in the agri-food Value Chains with the various importance. The main activities are also included in the agro-food value chain analysis as much as expected; 1) Production, 2) Marketing & Distribution, 3) Processing, 4) Supply of Inputs & Services and 5) Consumption.

The researchers mainly have studied on Institutional/Functional analysis which is the first step of Value Chain analysis. The other most studied area of interest is Economic/Financial analysis of Value Chain. Social and Environmental side of the Value Chain have been studied with the lesser of attention. It is underlined that researchers have generally used Mapping of the Value Chain as it is an important area of interest and the first step for the Value Chain analysis. The other tools are Demand & Supply analysis, Governance analysis and End Market analysis (phase 1-Export/Import condition) of Value Chains.

The most widely used Indicators of MAPPING are: 1) Mapping of Agents, 2) Mapping of Core process (Activities), 3) Marketing channels and 4) Flows of Products. For the GOVERNANCE analysis, the researchers have generally used: 1) The list of constraints, 2) Quality standards and 3) Rules & Regulations & Accession to market, technology and finance as a sort of indicators/outcomes. The DEMAND and SUPPLY conditions of the product have been investigated with the statistical data on: 1) Area sown, Yields, number of farmers, etc., 2) Export and Import statistics and 3) Prices of national and International level. The END MARKET analysis has been researched with the data of national and international market analysis. The last toll is SWOT analysis, a general tool which is widely used for the Value Chain analysis with the well known indicators of S-W-O-T (Strengths, Weaknesses, Opportunities, Threats).

The second important area of interest in Value chain analysis is Economic and Financial analysis. Value Added analysis is a top research area in the economical side of the Value Chain Analysis. Consumer behaviour and Financial analysis are also included in the case studies although they have some relatively minor importance. Value Added analysis has six different components: 1) The share of marketing and profit margin by agents 2) Cost of intermedite inputs, 3) Total output value, 4) Net Value Added 5) Gross Value Added and 6) Cost of Fixed capital, respectively. The research on Consumer behaviour of the Value Chain has been focused on: 1) Preferences of the consumers, 2) Attitude, 3) Behavior and 4) Value of the consumers. Financial analysis is another area of interest in the value chain analysis which generally concentrates on Cost of intermediate inputs, Total output value, Net Present Value, Internal rate of return, Cash flows and Cost of fixed assets, Break-even point.

Social analysis of value chain is an important side of the interest which covers social inclusion on the base of different gender and age group of people and also includes how much employment is created with decent working conditions.

Environmental analysis tries to evaluate the environmental effects of the value chain which explains the effects on human health, resource depletion and ecosystem quality mainly resulting in biodiversity decline. Environmental analysis of value chains has been executed by using different ways and approaches such as Hot spot analysis, Environmental Assessment and Life Cycle assessment. Hot spot analysis is an analysis which utilizes qualitative data while the other approaches are subject to quantitative data analysis. It is noted that environmental analysis has been given limited attention by the researchers and hot spot analysis is preferred more. Environmental analysis is a critical evaluation part of the BIOVALUE Project which targets the enhancement of biodiversity.

The concluding part of the deliverable comprises important data for the whole BIOVALUE project and will be used as input for the development of other WPs (WP3, WP4, WP5, WP6, WP7). The entire literature review is aiming here to focus on a conceptual and analytical framework of value chains and the modelling tools which are generally studied with the case study results proven. The figures given here try to scrutinize- the modelling tools and their related indicators which will be selected and implemented by the other WPs in their analysis.

Table 9.1 Tested and Selected Value Chain Modelling Tools

	Functional/Institutional Analysis	Economic/Financial Analysis	Social Analysis	Environmental Analysis
TESTED TOOLS	1. Mapping 2. Governance Analysis 3. Demand&Supply Conditions 4. Swot Analysis 5. End Market Analysis (Phase-1)	1. Value Added Analysis 2. Financial Analysis 3. Policy Analysis 4. End Market Analysis (Phase-2)	1. Employment Created Analysis 2. Gender Analysis 3.Decent Work Analysis	1.Hot Spot Analysis 2.Environmental Assessment 3.Life Cycle Assessment (A Software Requirement)
SELECTED TOOLS	1. Mapping 2. Governance Analysis 3. Demand&Supply Conditions	1.Value Added Analysis 2.Financial Analysis 3.End Market Analysis (Phase-2)	1. Employment Created Analysis 2. Gender Analysis	1.Hot SpotAnalysis (Qualitative Approach of Life Cycle Assessment)

Sources: Authors' elaboration from guidelines reviewed

Table 9.2 Mapping and Its Possible Indicators That Can Be Selected

INDICATORS	Types of data
Functional analysis table	Narrative
Mapping of core process	Schematic diagram, Narrative
Mapping of agents	Narrative
Mapping flow of products	Schematic diagram, Narrative
Marketing channels	Schematic diagram
Mapping knowledge and flow of information	Schematic diagram
Mapping of volume of products, number of agent sand jobs	Continuous data-Metric tons, numbers
Mapping the value at different level of VC	Metric tons, currency
Mapping of relations and Linkages	Schematic diagram, Narrative
Mapping of constraints and potential solutions	Schematic diagram, Narrative
Market channels	Schematic diagram, Narrative, %

Sources: Authors' elaboration from guidelines reviewed

Table 9.3 Governance Analysis and Its Possible Indicators That Can Be Selected

INDICATORS	Types of data
Types of rules and standards & regulations	Narrative
Matrix of regulations and agents	Matrix of table, Narrative
Quality standards	Narrative
Rewards and Sanctions	Narrative, values
Access to market, technology, finance, skills and knowledge	Narrative
Vertical-Horizontal integration	Narrative
Certifications and Labelling	Narrative
Economic support programs, subsidies and taxations	Narrative, %, values
Export, import duties	Narrative, %, values

Sources: Authors' elaboration from guidelines reviewed

Table 9.4 Demand-Supply Conditions and Its Possible Indicators That Can Be Selected

INDICATORS	Types of data
Area sown, yields, number of farmers and all agents	Hectares, Metric tons, numbers
Quantity of supply and demand	Metric tons
Quantity and Value of exports and imports	Metric tons, currency
Prices (National and International level)	Currency, agent based, time series
Supply utilization account	Metric tons distributions
Share in national economy	%

Sources: Authors' elaboration from guidelines reviewed

Table 9.5 Value Added Analysis and Its Possible Indicators That Can Be Selected

Indicators	Farmers	Collectors	Processors	Wholesalers/Distributers /Retailers	Consumers
Total output Value	Currency, %	Currency, %	Currency, %	Currency, %	Not applicable
Cost of Intermediate Inputs	Currency, %	Currency, %	Currency, %	Currency, %	Not applicable
Cost of Fixed Capital	Currency, %	Currency, %	Currency, %	Currency, %	Not applicable
Gross Value Added	Currency, %	Currency, %	Currency, %	Currency, %	Not applicable
Net ValueAdded	Currency, %	Currency, %	Currency, %	Currency, %	Not applicable
Share of Marketingand profit margins	%	%	%	%	Not applicable

Sources: Authors' elaboration from guidelines reviewed

Table 9.6 Financial Analysis and Its Possible Indicators That Can Be Selected

Indicators	Farmers	Collectors	Processors	Wholesalers/Distributers /Retailers	Consumers
Cost-Benefit ratio	%	%	%	%	Not applicable
Net Present Value	Currency	Currency	Currency	Currency	Not applicable
Payback period	Years	Years	Years	Years	Not applicable
Cost of variable inputs	Currency	Currency	Currency	Currency	Not applicable
Cost of Fixed capital	Currency	Currency	Currency	Currency	Not applicable
Internal rate of return	%	%	%	%	Not applicable

Sources: Authors' elaboration from guidelines reviewed

Table 9.7 Agents Behaviors and Its Possible Indicators That Can Be Selected

Indicators	Farmers	Collectors	Processors	Wholesalers/Distributers /Retailers	Consumers
Value	Likert scale	Likert scale	Likert scale	Likert scale	Likert scale
Attitude	Likert scale, willingness	Likert scale, willingness	Likert scale, willingness	Likert scale, willingness	Likert scale, willingness
Behavior	Quantity, Currency, Likert scale	Quantity, Currency, Likert scale	Quantity, Currency, Likert scale	Quantity, Currency,Likert scale	Quantity, Currency, Likert scale
Preferences	Likert scale	Likert scale	Likert scale	Likert scale	Likert scale

Sources: Authors' elaboration from guidelines reviewed

Table 9.8 Social Analysis and Its Possible Indicators That Can Be Selected

Indicators	Farmers	Collectors	Processors	Wholesalers/Distributers/ Retailers	Consumers
Labor needs	Number of workers	Number of workers	Number of workers	Number of workers	Not applicable
Women & Young Participation	M: % F: %	M: % F: %	M: % F: %	M: % F: %	Not applicable
Wage differentiation	M: Currency F: Currency	M: Currency F: Currency	M: Currency F: Currency	M: Currency F: Currency	Not applicable
List of safety risksand level	Narrative	Narrative	Narrative	Narrative	Not applicable
Number of persons employed in VC	Numbers	Numbers	Numbers	Numbers	Not applicable

Sources: Authors' elaboration from guidelines reviewed

Table 9.9 Hot Spot Analysis and and Its Possible Indicators That Can Be Selected: Impacts on Biodiversity, Natural Resource Depletion, Ecosystem Quality, Human Health and Climate Change

Indicators	Farmers	Collectors	Processors	Wholesalers/Distributers /Retailers	Consumers
Input consumption	LIKERT SCALE MEASUREMENT				
Energy consumption					
GHG emission					
Water consumption					
Land erosion and pollution					
Air pollution					
Water pollution					
Waste production					
Biodiversity					
Impact on environmental degradation on VC					

Sources: Authors' elaboration from guidelines reviewed

Table 9.10 Environmental Assessment and Indicators May Be Chosen: Impacts on Biodiversity, Natural Resource Depletion, Ecosystem Quality, Human Health and Climate Change

Indicators	Farmers	Collectors	Processors	Wholesalers/ Distributers/ Retailers	Consumers
Natural Resource Depletion					
Water resource depletion	m3 water eq	m3 water eq	m3 water eq	m3 water eq	m3 water eq
Ecosystem Quality and Human Health					
Use of fertilizer and pesticide	-N, P, K eq. -Active ingredient of pesticides	Active ingredient of pesticides	Active ingredient of pesticides	Active ingredient of pesticides	Not applicable
Climate Change					
GHG emission	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq	kg CO2 eq

Sources: Authors' elaboration from guidelines reviewed

10. Policy Recommendations

Value chain has a complex set of interrelated elements such as public and private agents, domestic and foreign markets, inputs, outputs, production factors, institutions, environment and natural resources, etc. These interrelations need to look at value chain in the different points of view for policy making. This task will try to formulate some policy recommendations for the sustainable value chains especially in extension of underutilized crops.

For Farmers

1. Special support for underutilized crops, local seeds should be implemented by input subsidies and deficiency payments. These are called as price or income support and subsidized cost of inputs. These provide farmers reduced cost of production and increased production income.
2. To train the farmers on sustainable farming practices such as organic, good agricultural practices, new technologies which diminish the over exploitation of natural resources.
3. To launch a support program on cost of investment of new technologies such as artificial irrigation and soil treatments.
4. To establish a certification and labelling program for underutilized crops. The increasing complexity of the labelling landscape have raised concern about their efficiency and capacity to help food consumers do well-based choices, particularly in favor of biodiversity.
5. Special supports to soil analysis for consistent fertilizer program, biological protection methods and techniques reducing chemical spraying.
6. To organize seed exchange events/organizations/festivals by local authorities or ministries on local and underutilized seeds and to support the networks/seed centers on it.

For Consumers

1. To address existing negative connotations and educate people and increase awareness of the nutritional benefits of underutilized foods and products.
2. Transformations are needed to limit the demand for increased food production by adopting healthier diets and reducing food waste, as well as limiting the consumption of other material goods and services that affect biodiversity, such as forestry, energy and freshwater supply.
3. To create programs for advertising underutilized foods of interest, encourage their use in everyday cooking, promote their use as both food and medicine, and stimulate improvements of culinary skills of consumers.
4. To design effective nutrition promotion strategies to encourage healthy eating in adolescence and targeting food supply and availability.
5. Principles of healthy diets and sustainable food consumption should be included into public health programs to raise children's awareness toward healthier and more environmentally friendly food consumption.
6. Policy makers together with nutritionists and agronomists should develop a food system which balances productivity, sustainability, and community' nutrition fulfillment to reinforce environmentally friendly food consumption behavior.
7. Efficient information provision to consumers should be 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.
8. Increasing tax on less environmentally friendly food products could be a way to promote organic products.

For entire value chain

1. It would be recommended to establish a short supply chain. 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. And cooperative marketing. These different forms of marketing should be supported or should be a subject of rural development projects.
2. To support the efforts of labelling practices on underutilized crops and local products.

11. Market Related and Practical Recommendations

Some recommendations can be given as follows to shape and establish more sustain agri-food value chain which are linking with the market conditions. These are;

1. It would be recommended to conduct a farmer market organization. Farmer market is a physical Marketplace intended to sell foods directly by farmers to consumers. Farmers' market can offer farmers increased profit over selling to wholesalers, food processors, or large grocery firms. By selling directly to consumers, produce often needs less transport, less handling, less refrigeration and less time in storage. By selling in an outdoor market, the cost of land, buildings, lighting and air-conditioning is also reduced or eliminated. Farmers may also retain profit on produce not sold to consumers, by selling the excess to food-processing firms. This can be organised by the local government such as municipalities in each local community. This also provides very important benefits to consumers and communities.
2. Another recommendation is to establish online platform for underutilized, local crops to meet with the potential consumers. Farmers or farmers group should assist to have web-based marketing platforms. Improve linkages between farmers and consumers, through local markets and supply chains.
3. There is a need to implement policy strategies to raise consumer awareness on sustainable food value chain by linking incentives to develop healthy and sustainable food production and creating new markets for labelled products.
4. It would be recommended to take actions and policy interventions to improve the environmental, economic and health outcomes in primary schools. The health benefits to public due to school meals may be enriched through relative targeted actions for school meals. This would be realized by public sector procurements, particularly those that support more significant contributions of small companies and display superior standards of food quality, nutrition, and sustainability.

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