Raising the bio-based industrial feedstock capacity of Marginal Lands

Value chains for feedstock from marginal land

Deliverable 6.1.

Date: 28. March 2024

Authors: Karen Hamann (IFAU); Konstantin Engelbrecht (inter3); Michael Glemnitz (ZALF); Oscar Ruiz (UNSAM); Raul S. Lavado (UBA); Romain Pirard& Duduzile Ngwenya (SUN); Susanne Paulrud& Cecilia W. Roslund (RISE); Thomas Hoffmann (ATB), Theodora Kalea (CluBE); Jeronimo Gonzalez (CICYTEX); Tamás Szolnoky (PILZE); Philipp Grundmann and Trang Dam (ATB).

Funded by the European Union

Technical References

Project Acronym	MarginUp!
Project Title	Raising the bio-based industrial feedstock capacity of Marginal Lands
Grant Number	101082089
Project Coordinator	Philipp Grundmann Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) Email: marginup@atb-potsdam.de; pgrundmann@atb-potsdam.de
Project Duration	December 2022 – November 2026

Deliverable No.	6.1
Dissemination level [1]	PU
Work Package	6
Task	6.1
Lead beneficiary	IFAU
Contributing beneficiary (ies)	inter3; CLUBE; ATB; SU UNIVERSITY; CICYTEX, PILZE-NAGY; RISE; ZALF; UBA; UNSAM
Due date of deliverable	31. March 2024
Actual submission date	28. March 2024

[1] PU = Public
PP = Restricted to other programme participents (including the Commision Services)
RE = Restricted to a group specificed by the consortium (including the Commision Services)
CO = Confidential, only for members of the consortium (including the Commision Services)

Document history

V	Date	Beneficiary	Author/Reviewer
1	22. March 2024	IFAU	Karen Hamann (Author)
2	26. March 2024	Inter3, CluBE	Konstantin Engelbrecht, Theodora Kalea (Reviewers)

3	27. March 2024	ATB	Philipp Grundmann
4	28. March 2024	ATB	Philipp Grundmann, Thi Huyen Trang Dam

MarginUp! in a nutshell

The MarginUp! project proposes solutions to secure use and return profitability on marginal lands while enhancing biodiversity by cultivating climate-resilient and biodiversity-friendly non-food crops for sustainable for industrial feedstock on marginal lands.

Working closely with land managers, farmers, and stakeholders from the growing bioeconomy industry, MarginUp! will create sustainable and circular value chains and increase the resilience of rural farming systems. To further improve biodiversity and environmental benefits, MarginUp! will focus on understanding which marginal lands are suitable with the lowest impact for low indirect land-use change (ILUC) biomass production.

MarginUp! will provide viable outcomes to ecosystems which are water-stressed as a result of climate change, including desertified areas of Mediterranean and Central European member states, as well as contributing to restoring and stimulating ecosystems in abandoned mine lands, and boosting land yield and health in low productivity marginal lands.

MarginUp! Is building on learning from seven Use-cases: Five implementations across Europe – in Spain, Greece, Sweden, Germany, and Hungary – as well as Use-cases in Argentina and South Africa, together increasing the replication potential of the project's results. MarginUp will identify the best practices for sustainable biomass production and biobased products that safeguard biodiversity and local ecosystems. Each Use-case considers the current use and properties of the area and proposes crops and crop rotation strategies that enhance biodiversity and increase soil productivity according to local requirements from Mediterranean soils in Spain to mining lands in Greece, boreal soils in Sweden, wetlands in Germany, desert lands in Hungary, degraded pastures in Argentina, and areas with bush encroachment in South Africa. The proposed crops create a sustainable supply of resources to foster the development of the bioeconomy businesses at local and regional levels while providing ecosystem benefits and building resilience to climate change.

On that basis, the MarginUp! project will enhance European industrial sustainability, competitiveness, and resource independence, by reducing the environmental footprint, including on biodiversity, enabling climate neutrality and increasing resource efficiency (particularly through upcycling and cascading use of biomass) along 5 value chains, and developing innovative bio-based products and enhanced technologies that will lessen EU reliance on fossil-based products.

To stay up to date with MarginUp! project events and reports, follow us on Twitter (@MarginUp_EU), LinkedIn (MarginUp! EU) or visit www.margin-up.eu

Summary

Marginal lands are areas that has different limitations for conventional crop production, and the term is used to describe several types of unproductive or underutilized lands, from fallow agricultural land to decommissioned mines (Olsson et al, 2023). Marginal land could offer opportunities for gathering or harvesting feedstock that could be used for producing **biobased materials, bioenergy, and food and feed** products thus, an untapped resource that could be used to promote the uptake of bioeconomy. We have investigated the value chains of the seven Use-cases connected with the product, thus value for biobased materials, bio-oils, agri-food products and bio-energy in five EU countries, South Africa and Argentina.

The scope of our analysis was to understand the factors and mechanisms that can **induce and sustain agri-food and biobased value chains**, a concept we define as **value chain performance:** the existence / occurrence of coherence, stability and transparency within a given value chain in such a way that these three critical factors enable the value chain to exist, expand and adapt. We also investigate the impact from attributes on creating market-pull for industrial feedstock. We build our findings on first-hand information retrieved from interviews and focus groups organized for each of the seven Use-cases, results provided from other WPs of the MarginUp project, and desk research. The report-at-hand is elaborated by IFAU in close collaboration with inter3 (stakeholder analysis and mapping of value chains); ZALF (biodiversity indicators); RISE (defining marginal land and farming systems) and, CLUBE (leading the coordination of the Use-cases).

In the report we have investigated value chains that are at a very Early-Stage of their development (for example in Spain and Germany), value chains that are Emerging (MDF-boards in Greece and bio-oils in Sweden), and Existing value chains like the Hungarian mushroom example and the Greek lavender oils. Based on the analysis in the report, we can conclude that there is no single solution as to how the three critical factors Coherence, Stability and Transparency should materialise for a value chain to demonstrate performance. Rather, **all three critical factors must appear to enable a specific value chain to grow, expand and diversify and so, enable the demonstration of value chain performance but, the appearance or materialisation of the critical factors vary according to the development status of the value chain.**

Attributes for bio-based products would appear most relevant for products targeted at the consumer market e.g., biofuel, lavender oils and, MDF-boards. Attributes communicating about marginal lands or biodiversity would be difficult to apply unless they were incorporated into a certification scheme. Attributes that promoted the environment and nature would appear relevant to environmental-conscious consumers. From the focus group results it is evident that attributes such as “produced with biomass from marginal land”; “preserves biodiversity” or “the product helps to restore marginal land” would not stimulate a demand for industrial feedstock produced on marginal land. **The market-pull for industrial feedstock stems from availability, specifications to quality and especially price including costs for transportation and handling.**

Disclaimer

Table of Contents

MarginUp! in a nutshell 3

Summary 4

Disclaimer 5
List of Acronyms 8
List of tables 9
List of figures 9
Key words 10
Definitions 10

1. Introduction 11

1.1. About the report 11

1.1.1. Introduction and scope 11

1.2. Introducing the Use-cases 13

2. Methodology 16

2.1. Research design – value chain performance 16

2.1.1. Conceptual framework 16

2.1.2. Analytical approach – value chain performance 17

2.1.3. Data gathering strategy 18

2.2. Research design - attributes and market-pull 19

2.2.1. Analytical approach 19

2.2.2. Data gathering strategy 19

3. Positioning the Use-cases and their value chains 21

3.1. Greece 21
3.2. Spain 23
3.3. Sweden 24
3.4. Hungary 26
3.5. Germany 27
3.6. Argentina 29
3.7. South Africa 30
3.8. Similarities and differences between the Use-case value chains 32

4. Analysis of the critical factors for value chain performance 34

4.1. Understanding Coherence 34
4.2. Understanding stability 36
4.3. Understanding Transparency 37
4.4. Ranking of the indicators for Coherence, Stability and Transparency by value chain typology 39

5. Identifying market-pull 42

5.1. Use-cases' products and customers 42
5.2. Attributes for market pull 44

5.2.1. Attributes discussed by all focus groups 44

5.2.2. Comments about attributes and market-pull from Use-case focus groups 45

5.3. Attributes and market-pull for industrial feedstock 48

6. Pulling the report together 51

6.1. Discussion 51
6.2. Implications of results 54

6.2.1. Implications of results for development of the Use-cases 54

6.2.2. Implications of results for the MarginUp! project 55

7. Concluding remarks **57**

8. Selected references **58**

9. Annexes **59**

9.1. Questionnaire for interview about value chain performance **59**

9.2. Procedure for Use-case focus groups **61**

List of Acronyms

EU	European Union
ZF	South Africa use cas
HU	Hungarian use case
DE	German use case
GR	Greek use case
ES	Spanish use case
AR	Argentina use case
VC	Value chain
MDF	Medium Density Fiberboard
CBD	Cannabidiol
FSC	Forest Stewardship Council
SME(s)	Small to medium-sized enterprise (s)
Q (No.)	Question number
BREEAM	Building Research Establishment Environmental Assessment Methodology

VERDE	Valoración de Eficiencia de Referencia de Edificios
LEED	Leadership in Energy and Environmental Design

List of tables

Table 1 Presenting the seven Use-cases and their value chains 14

Table 2 The most important indicators for the critical factors by value chain typology 39

Table 3 Overview of the Use-cases' products and customers 42

Table 4 List of attributes that were investigated by all focus groups 45

Table 5 Specific attributes discussed by the Greek focus group 46

Table 6 Key issues discussed by the Hungarian focus group 47

List of figures

Figure 1 Mechanisms of value chain performance and the three critical factors 12

Figure 2 Value chains and market-pull 16

Figure 3 Analytical design – value chain performance 17

Figure 4 Research design for analysis of market-pull 19

Figure 5 Collection of attributes to be explored in focus groups 44

Figure 6 Relevance of attributes for creating market-pull for feedstock 49

Figure 7 The mechanisms of value chain performance 52

Key words

- Value chains for Food, Materials, Biofuels
- Value chain performance
- Critical factors
- Market-pull
- Product attributes

Definitions

Attributes: (Perceived) quality characteristics of a certain product.

Bio-based product: A product made fully or partly from biobased materials. Biobased products include food and agricultural products, biobased chemicals and materials, bio-fuels (bio-oils) and, biobased intermediary products and compounds.

End-user: The entity that buys the biobased product for using it. The entity may be the consumer, a business or the public sector.

Feedstock: Organic material that is processed for the making of biobased products. In MarginUP, the organic material, hence the feedstock, is derived from harvesting biomass (fibre and oilseed crops, wood, grasses and, perennials) from marginal lands.

Marginal land: Areas that have different limitations for conventional crop production due to soil conditions, climate change, pollution or other conditions that hamper conventional agricultural production. The term is used to describe several types of unproductive or underutilized lands, from fallow agricultural land to decommissioned mines.

Market-pull: The market situation when the demand is stronger than supply, particularly in emerging markets where customers' interests in the new product exceeds production.

Paludiculture: (planted) vegetation that grows on fenlands, for example some types of grasses

Use-case: The experimental clusters of the project; each based on a type of feedstock produced on marginal land to make a biobased product. The Use-case involves primary producers, processors, market actors, and innovation intermediaries and researchers.

Value chain: The sequence of actors from feedstock production to end-user working together to bring a product from field to market.

1. Introduction

1.1. About the report

1.1.1. Introduction and scope

Marginal lands are areas that has different limitations for conventional crop production, and the term is used to describe several types of unproductive or underutilized lands, from fallow agricultural land to decommissioned mines (Olsson et al, 2023). Marginal land could offer opportunities for gathering or harvesting feedstock that could be used for producing **biobased materials, bioenergy, and food and feed** products thus, an untapped resource that could be used to promote the uptake of bioeconomy. The agricultural sector accounts for 20% of the bioeconomy and is due to its significance very relevant as a feedstock provider, user of biobased products and bioenergy, and as supplier of food and feed products. The increased availability of feedstock would enable a value chain to form as this biomass would need to be processed for a certain use or market. This indicates that the existence of a market is essential in discussions about whether or not to expand the production or availability of feedstock. EU's bioeconomy strategy (European Commission, 2018) aims to stimulate the transition towards a bioeconomy in Europe thus, a context where more industrial products are made from renewable biological resources – this could be e.g., feedstock from marginal land.

For the bioeconomy to properly take hold in today's economy and society it is required that, biobased value chains offer industrial products that are competitive to existing ones and that the biobased value chains function in the sense of enabling a smooth transition of feedstock to market-ready product in a commercial context. However, the diversity of value chains, feedstocks, products, and contexts surrounding the value chains, producers and markets widely differ among countries.

It is therefore relevant to understand the factors and mechanisms that can **induce and sustain agri-food and biobased value chains**, a concept we define as **value chain performance:** the existence / occurrence of coherence, stability and transparency within a given value chain in such a way that these three critical factors enable the value chain to exist, expand and adapt.

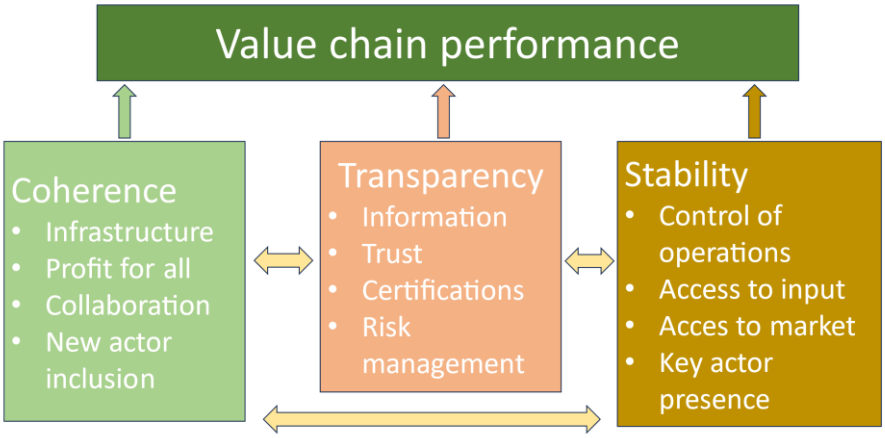
The scope of the report is:

- ***To analyse value chain performance by the seven Use-cases based on investigation of the critical factors: coherence, stability and transparency; and***
- ***To identify if certain attributes might stimulate market-pull for feedstock.***

Learnings from other EU projects (refer to 4.1.3) about new grass-based value chains; innovative food value chains; value chains in a transition context; and value chains that encourage rural entrepreneurship have identified a few

critical yet common factors that enable and promote the shaping and functioning of agri-food and biobased value chains: **Coherence, Stability and Transparency**. Each of these critical factors encompass a range of indicators or conditions as visualised in Figure 1 and further explained below.

Figure 1 Mechanisms of value chain performance and the three critical factors



Value chain coherence: is the ability of a value chain to remain connected under normal and disruptive circumstances. Coherence is related to: infrastructure (logistics, storage facilities, and institutional framework); profitability for all actors; potential for development of the value chain and by the involved actors; the way collaboration is implemented and practiced, possibilities for new actors to take part in the value chains.

Value chain stability: refers to the ability of the value chain actors to maintain (and regain) control of own operations under normal and disruptive circumstances; the continuous access to inputs (biomass), goods and services; access to markets; the continuous presence of key actors in the value chain; the actors' possibilities to manage operations under disruptive situations and, actors' relationship forming.

Value chain transparency: is about access to trustworthy and open information; clarity about price formation and payments; the use of standards and certifications and, the actors' trust in such; the trust in dealing with fraudulent practices; the actor's possibilities to manage risk, and predictability in regulations.

With only one of the critical factors occurring, the value chain would not develop to its full potential. It is the materialisation and interplay between coherence, stability and transparency that would enable a certain value chain to develop towards its potential, and even beyond so by exploiting opportunities for diversification or circularity. The key issue is therefore not what factors shape a value chain, rather what factors enables a value chain to develop and grow, hence the mechanisms and interplay that stimulate and enable value chain activities, collaboration and exploitation of opportunities.

The report-at-hand is elaborated by IFAU in close collaboration with inter3 (stakeholder analysis and mapping of value chains); ZALF (biodiversity indicators); RISE (defining marginal land and farming systems) and, CluBE (leading the coordination of the Use-cases).

An extended thank you should go to the Five European Use-cases (leaders and Use-case actors) and the international Use-cases in South Africa and Argentina for their strong engagement in data collection and discussion of results.

1.2. Introducing the Use-cases

The report analyses the value chains of seven Use-cases as presented in Table 1. The analysis will look into value chains in the food sector, and value chains for materials and biofuels. For all value chains, it is a requirement that they build on valorisation of feedstock or biomass produced or gathered on marginal land; this is further elaborated in chapter 4. Details about the Use-cases and their value chains are available in D1.1, D3.1 and D5.1 so, for the report-at-hand we choose to provide those details only that are relevant for analysing value chain performance and market-pull. For our analysis, we have decided to segment the value chains according to their development stage. This is because the critical factors for inducing value chain performance change as the value chain becomes more mature and commercial (Hamann et al, 2019) as will be analysed in chapter 5. The four development stages we will work with are:

- Early-stage: This stage is characterised by minimum two value chain actors engaged, for example a research institute and a technology provider, or a research institute and feedstock producers. There is no commercial activity yet and, both the technology and the product need further development to induce the shaping of a value chain.

- Emerging: The emerging value is characterised by a beginning economic activity, for example from the marketing of proto-types, or first procurements of biomass. Typically, the product or technology is not fully completed yet. More actors are starting to engage with the value chain particularly those that would invest in maturing the technology. There is still much research and trials going on to develop the value chain. The market is in development and/or the product is in development for an existing market.

- Existing: Value chains at this development stage operate on full commercial terms with supply, demand and profit being the at centre stage. Research and development work still goes on, but this is for actors' business development, not for shaping the value chain itself. Products and technologies exist, there is a market offering economic gain, there are opportunities for diversification and, actors have formed relationships.

- Hereto should be added Idea which is the stage before Early-stage. The Idea-stage is characterised by discussions about potential value chains from research findings, discussions among value chain actors, or an entrepreneur's idea. There is no value chain and no commercial activity.

Table 1 Presenting the seven Use-cases and their value chains

Value chain status	Use-cases value chains, products and sector
Existing VC	ZA: Invasive trees for pellets, charcoal, firewood and biochar (Bioenergy)
	GR: Lavender oil for cosmetics (Materials)
	AR: Cattle farming and honey production on grasslands (Food)
	HU: Oyster mushrooms produced on lignocellulosic substrate (Food)
Emerging VC	GR: Acacia wood for MDF boards (Materials)
	SE: Turnip rape for biofuels (Bioenergy)
Early-stage VC	DE: Paludiculture for biochar and green roof substrates (Materials)
	ES: Hemp and kenaf for fibres for MDF boards (Materials)
Idea VC	HU: Fertilizer made from digestate from biogas (Materials)
	HU: Animal feed made from spent mushroom substrate (Feed)
	AR: Camelina oil crop (Bioenergy)
	GR: Honey made from *pseudoacacia* blossoms

In the next chapter 4 we present our methodology and data gathering strategy. In chapter 5, we present the Use-case value chains in more detail, the motivation for the Use-case and its connection to marginal land. Next, in chapter 6 we deliver a cross-cutting analysis of all the value chains to arrive at an understanding of how the critical factors coherence, stability and transparency materialise at an aggregated level. In chapter 7 we investigate market-pull for industrial feedstock by emphasizing the potential in attributes for creating market-pull. Chapter 8 provides the discussion including implications of the results for Use-case development and the MarginUp project and, chapter 9 provides the concluding remarks.

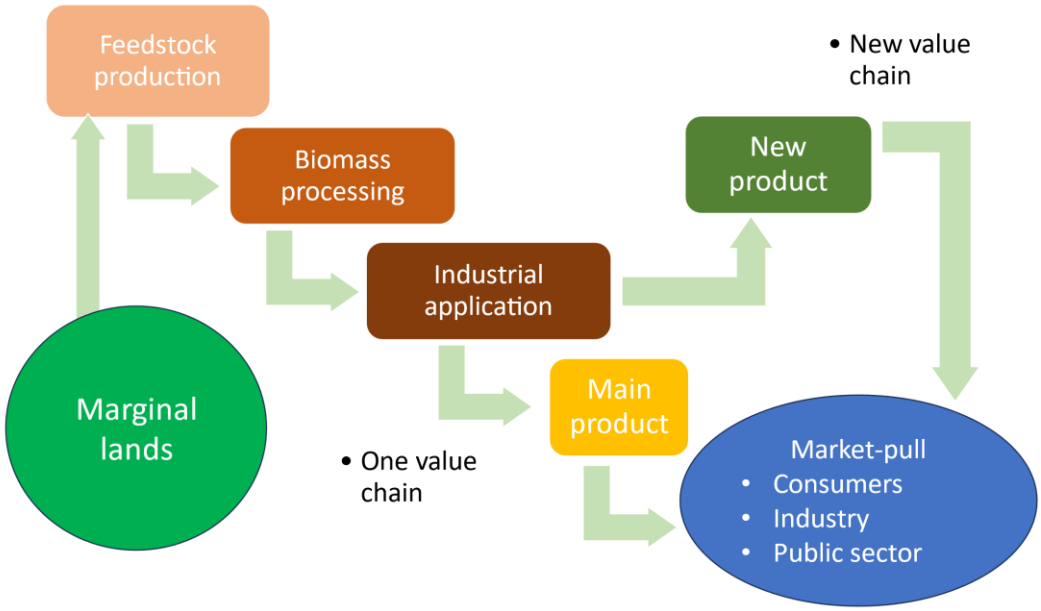
2. Methodology

2.1. Research design – value chain performance

2.1.1. Conceptual framework

The report is elaborated as an explorative analysis based on a qualitative research design building on empirical data. We have elaborated a conceptual framework inspired by the principles of value chain analysis and market analysis. For our research, **we consider a value chain as a sequence of actors that collaborate in trading relationships to increase the value of a product.** The more value is generated, the closer the product is to the market (downstream). In our report, we have investigated the Use-cases' value chains from feedstock production to end-users as shown in Figure 2 as well as circular value chains when such appeared. For our analysis we will use a value chain model that encompasses the steps Feedstock production (growing and harvesting of feedstocks); Biomass processing (treating the feedstock to produce an ingredient, material or compound that can be used in manufacturing); Industrial application (processing of the biobased element to produce a product for the market), and Market. We consider three main markets: Industry (professional market, including farmers), Consumers and the Public sector. Logistics, infrastructure and information should in principle be available between each of the steps; in Figure 2 symbolised with arrows.

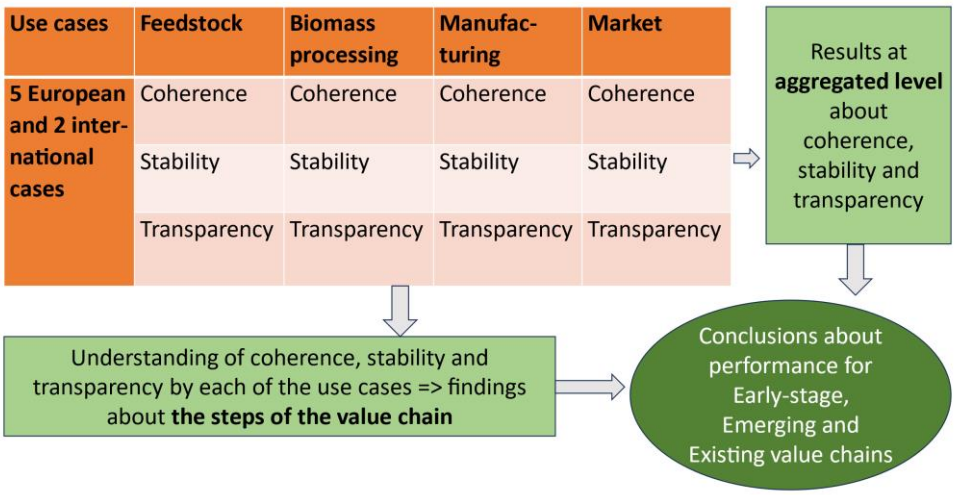
Figure 2 Value chains and market-pull



2.1.2. Analytical approach – value chain performance

Due to the explorative nature of the analysis, we investigate Use-cases' main value chain and, if additional and/or circular value chains exist, such will be included too to investigate factors that characterize coherence, transparency and stability of the value chains. The analytical design is illustrated in Figure 3.

Figure 3 Analytical design – value chain performance



The analysis is performed at an **aggregated level**. This implies that the indicators of the critical factors are identified and the consequences first understood for the specific value chain, for example the impact of information availability on the dairy value chain performance. Then, we aggregate our understanding of the impact from this specific dairy value chain with learnings about this indicator from all other value chains. This way we can draw out findings about how each of the indicators (refer to Figure 1) seem to impact on a value chain; this is the aggregated level we will draw conclusions from. From the explorative analysis of our data, we also delineate findings about how the impact of the indicators by each step of the value chain. For example, the impact of access to information for feedstock producers compared to the impact of the same indicator but by market actors. This approach provides results about how some critical factors may have a bigger impact on some steps of the value chain. Based on these analyses, we can provide our final conclusions about how coherence, stability and transparency impact on value chain performance for Early-stage, Emerging and Existing value chains.

2.1.3. Data gathering strategy

The analysis of value chain performance is based on an integrated approach including desk research, interviews with actors of the Use-cases, and Use-case consultations. The first step was to carry out desk research about value chains similar to those of Use-cases by retrieving information from other H2020 projects:

- *Transition to sustainable legume-based systems in Europe TRUE (2017-2022) => innovative agri-food value chains based on new cropping systems and mechanisms for sustainable value chains;*
- *Replicable business models for modern rural economies RUBIZMO (2019-2021) => new value chains and business models for food, agriculture and biobased products;*
- *Grass-based circular business models for rural agri-food value chains GO-GRASS (2019-2023) => new value chains, markets and business models for grass-based products targeted at livestock production, energy, materials.*

This led to the model value chain depicted in Figure 2 and consisting of the steps Feedstock production; Biomass processing; Industrial Application and, Market. Desk research included the review of industry reports, literature, results from other projects, websites, and information retrieved from other Deliverables in MarginUp. D5.1 (Engelbrecht K., 2023) provided an analysis of the Use-cases' value chains and conclusions about the structures and actors involved. Also, D5.1 provided information about challenges and opportunities for organizing the Use-case value chains. From D3.1 (Paulrud S. et al, 2023), we gained insights to the farming systems to produce feedstocks, and the production methods for processing the biomass and producing the final products, thus details about each step in the value chains and the linkages between the steps. This report also provided information about stakeholders of the Use-case value chains. The approach to marginal land was given in D1.1 (Olsson et al, 2023) as well as maps of Use-case stakeholders. Findings from D1.1, D3.1 and D5.1 were useful for shaping the data gathering strategy, especially the questionnaire for interviews.

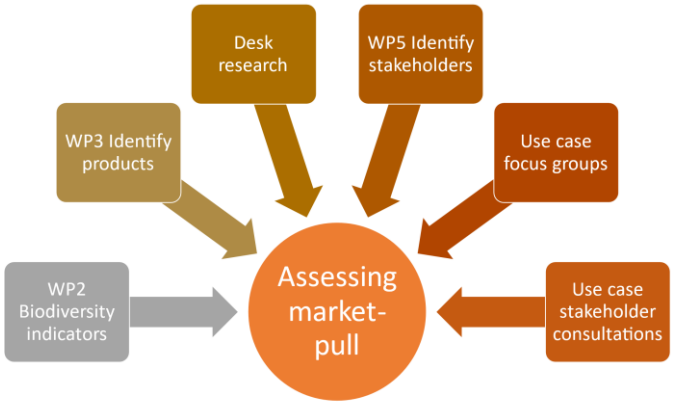
IFAU developed a questionnaire that would be used for qualitative interviews with Use-case stakeholders (refer to Annexes). The interviews were focused on gathering actors' views on what characterize **coherence, stability and transparency** in the value chain they would be involved in, and their views on challenges and opportunities for developing their operations in this specific value chain. All Use-case leaders were asked to conduct 3-5 in-depth interviews with actors either directly connected with the Use-case value chain or otherwise important for the development of the Use-case. This resulted in 25 interviews that were conducted in the local languages during October 2023 – February 2024 and reported to IFAU. Once each Use-case had completed the interviews, IFAU and the Use-case leader met for a follow-up discussion. This proved very useful for the research because the meeting shed light on the background for the Use-case; the development status of the value chain and, the drivers and barriers for developing the Use-case.

2.2. Research design - attributes and market-pull

2.2.1. Analytical approach

In-depth market research will be carried out at a later stage and compiled in D6.2. We therefore focused the research about market-pull to an indicative assessment of whether there would be market for the Use-case product(s) and an analysis of the attributes that might stimulate a market-pull for the Use-cases' main product(s). The analysis of market-pull was carried out as an explorative analysis with on a qualitative research design and based on results from other WPs, Figure 4.

Figure 4 Research design for analysis of market-pull



2.2.2. Data gathering strategy

The analysis of market-pull and product attributes builds on a dual approach: Desk research combined with focus groups and stakeholder consultations. Desk research was carried out to gather basic information about market trends for the Use-cases' products. Desk research included trade magazines, market reports, literature, newsletters and websites. Use-case leaders organized focus groups or stakeholder consultations to discuss about attributes and their relevance and to assess if there would be a market-pull for the main product(s) of the Use-case.

Findings from WP2 (Glemnitz et al, 2023) provided inspiration for attributes related to biodiversity. Findings from WP3 (Paulrud et al, 2023) were used to support the choice of products to be researched by each Use-case, and to extend the list of attributes. Findings from WP5 (Engelbrecht K. 2023) provided a comprehensive overview of stakeholders involved in the Use-cases, the value chains and products and so, information that was used to structure the focus groups. IFAU compiled the list of attributes to be discussed and provided guidelines for organizing the focus groups and consultations (refer to Annexes). Use-case leaders hand-picked the actors to be

involved in this research and selected the 1-2 most important products to be discussed. The focus groups were conducted during January-February 2023. More than 30 actors were consulted either by joining one of the five European focus groups or in bilateral consultations organized in South Africa and Argentina. Results from the focus groups and consultations were compiled by the Use-case leaders and provided to IFAU.

3. Positioning the Use-cases and their value chains

In this chapter we introduce the Use-cases with the connection to marginal land; the motivation behind the Use-case and, the value chains of the Use-case. The Use-case motivation provides a context for understanding of the value chain(s) including status of the value chain and the driving force(s). Then, we provide for each Use-case, information about how the factors **Coherence, Stability and Transparency** materialise in each of the value chains. This information is derived from interviews with diverse stakeholders of the Use-case carried out by Use-case leaders. Therefore, diverse perspectives on the same topic can appear in the text, e.g., about dominant position in the value chain. The presentation of each Use-case is deliberately kept short in order to only focus on information that is relevant for describing coherence, stability and transparency in the value chains. To ease the reading, we have marked the **products**, and implicitly a reference to the value chains.

3.1. Greece

Positioning the Use-case and its connection to marginal land: The Greek Use-case is located in Kozani, Western Macedonia, in an area with former lignite mining activities. The top soil in the deposition areas is mixed with ashes from the lignite processing. The Public Power Corporation (DEI) owns the land. The main challenge in the Greek use-case is to demonstrate that former lignite mining areas can be restored and turned into areas for production of feedstock and enhanced biodiversity. This will be done by planting 20 hectares with *pseudoacacia*, chestnut and oak trees and, lavender starting in 2023. The Greek Use-case is driven by entrepreneurial companies with limited or no support from the Government. There are several opportunities for using these biomasses hence, the Greek case includes more value chains. One value chain is the **processing of lavender into essential oils** for cosmetics targeted the Greek and export markets, with the waste potentially used as fertilizer or insect repellent to protect livestock in fields. There are several lavender processing facilities in the area, thus a potential lavender-processing cluster. Beekeeping is a traditional occupation in Greece and the Use-case will test if honey could be produced from the *pseudoacacia* blossoms.

Kozani's area is rich in forests and agricultural holdings so, wood processing is a well-established industry. An example of a wood-related value chain by the Greek Use-case is the processing of lignocellulosic material from low-quality wood to make **MDF boards** (construction materials), with the waste being used as bioenergy (heat and electricity). The MDF board value chain has been ongoing since 1995, is export-oriented and, builds on the use of wood that sawmills do not use for e.g., timber production. The companies involved in the Greek case are discussing collaboration across the current value chains, for example the use of lavender waste for bioenergy, or use the bioenergy generated for production at the lavender distillery.

Coherence: The **lavender** processors are not currently united and call for a public initiative to connect the value chain in the sense of promoting the lavender products to a wider market. Greek **honey** is recognised as a high-quality product. The Beekeepers' Association works to promote the honey but beekeepers find that a better organisation of the members is important for claiming a higher price for the honey, better quality, and improvement of farming methods through education. Also, the Beekeepers' Association does not have a quality testing laboratory of their own. The current organisation level among beekeepers is very low with most beekeepers acting on their own behalf. Honey traders determine prices, supply and demand. Imports of honey from e.g. China has an impact on the Greek honey sector: lower prices and high risks of fraud. Effective controlling mechanisms against fraud and profit for all are essential elements for keeping the honey value chain together.

The sourcing of biomass for the **MDF board** value chain is challenged by the lack of coordination and logistics. The company producing the MDF boards explains that currently, all the biomass processed comes from known suppliers and there is a growing demand for the company's products. Much more biomass is available yet remains unexploited due to lack of supply chain coordination and logistics. The MDF-producer recommends to organise a coordinating body to connect biomass providers with the wood industry, sawmills and the energy sector.

Stability: Entry barriers to start as a professional **beekeeper** are low. A start-up period of five years and attending training should be considered before a reasonable production can be achieved. Seasonality and weather conditions have significant impact on beekeeping and lead to vast fluctuations in honey production year-on-year. For those whom make a living as a beekeeper, weather damages could lead to a closure of the business. Large **honey** producers are at the forefront of securing their sales in terms of prices and customers, leaving smaller producers with the challenge to find appropriate customers for the honey. The consequence is often that smaller producers are forced to sell the honey at lower prices. Currently, the **lavender** sector is facing large supply and less demand so, a bigger market is anticipated to underpin the stability of the value chain. The lavender sector finds that a seal of local quality could be useful for creating value through increased market volume and higher prices. An additional benefit of a potential local quality seal might be that newcomers would have easier access to the value chain. Access to input (feedstock) may be seasonal or year-round; both situations occur for the company producing **MDF-boards**. However, maintaining a good price and a consistent quality is claimed to be more important for value chain stability than seasonality of the biomass. This is because the biomass, in this value chain, can be used for MDF-boards or energy production. Due to high demand for MDF-boards in the construction sector this value chain is perceived to have a low risk for those involved.

Transparency: Information about beekeeping is widely available to anybody whom would like to start in this profession. Due to low profitability, it is claimed in interview that there are issues about declaring income and taxes. Most of the **honey** produced is of organic standard and certified as such. Changing business conditions (e.g., change in government, in regulations, in prices and in taxation) creates an unpredictable environment that can have a significant impact on an investment. For example, it takes 12-14 months to build a new bioenergy plant. Good agricultural practices are not defined for lavender production and there are no certifications for the harvested crop. New data must be provided for the safety of **essential oils** because of new EU rules. There are no certifications for

the whole lavender value chain. There are examples of other companies that have mixed lavender oil with vegetable oils and so, committed fraud. **Wood** trade has to comply with several regulations and requirements for traceability to prevent illegal trade with protected species. As over 80% of the forests in Greece are state-owned, the wood pricing mechanism is defined by the State; a system that has resulted in stable (and foreseeable?) prices. This may contribute to reduce the actors' risk from being involved in wood-based value chains.

3.2. Spain

Positioning the Use-case and its connection to marginal land: The Spanish Use-case is located in Extremadura, a region in the West of Spain on the border with Portugal. The Use-case is motivated by a research organisation with the aim to explore new opportunities for farmers to counteract poor soil fertility. This will be done by planting crops (**hemp and kenaf**, 3 hectares as field trials in 2023) that stimulate soil microbiology and therefore, support the cultivation of arable crops like corn and grain. The fibre crops will also be introduced in crop rotations with tobacco plants in order to reduce nematodes in the soil. The hemp and kenaf crops are processed into **natural fibres to be used for making bio-based construction materials** (precast concrete modular panels) in order to substitute the use of plastic particles.

The Spanish value chain includes a seed supplier, an agricultural cooperative (farmers), a fibre processing company, and a company making the precast concrete panels. The latter company has been involved in sustainable construction materials since 2020 and claims to be part of the founding partnership of the Use-case. Hereto should be added research and knowledge transfer organisations. In contrast to the other Use-cases, the Spanish case involves Spanish entities and a Portuguese company (the seed supplier). Overall, the Use-case is anticipated to lead to a boost in the regional economy and implementation of circular systems.

Coherence: The ability to maintain a strong and continuous connection between the different entities involved in the value chain for keeping it together was emphasized as critical by the company that has invested in a facility to make construction materials in the region. This investment is also seen as a way to diversify local agriculture from tobacco production to production of **natural fibres**. The Spanish value chain is at a very early stage of its development but, the involved actors reveal that there are many possibilities for valorising the seed, fibres, straw and oils from the hemp and kenaf – once infrastructure for valorisation would be in place. A coherent value chain would be possible if all actors from field to market could be included. The fibres need to be processed before they can be used for making the **construction materials**, and only one company in the value chain possesses this technology. It is claimed in an interview that this monopolistic position could endanger the value chain's stability but, in other interviews the presence of the fibre processing unit is regarded as essential for value chain coherence. The investment in this processing unit was made in 2023 by one of the Use-case companies. None of the interviews have pointed to missing links in the Spanish value chain.

Stability: In several interviews, the Use-case partners explain that potential for generating income and access to processing facilities are two fundamental requirements for developing an early-stage value chain; especially income generation for **farmers** has been underlined. As the farmers' cooperative explains: all involved actors need to make a profit and this depends on the margins offered by supply and demand. Interviews reveal that there are many opportunities for new-comers in this value chain because of its Early-stage hence, new-comers have the opportunity to contribute to the shaping of the value chain. The demand for the value chain's end-products **(bio-based construction materials)** needs to be there for the value chain to develop. Despite the Early-stage, interviews point to downstream actors (fibre processors and producers of construction materials) as those actors with the most power over the value chain's development and stability. New-comers could quite easily join the value chain and this would bring added knowledge, diversification and new resources.

Demand for the products from the Spanish value chain and government actions are considered as those factors with the highest potential for impacting the development of the **hemp and kenaf** value chains. Current demand for hemp-based construction materials is growing in Spain and other parts of Europe, it is claimed in more interviews. One respondent (industrial company) explained that, *stability* was the ability to constantly develop the activities in the different links of the value chain while maintaining control over own operations and, that it is about considering the value chain as a tool for generating trust and commitment (of resources). Further to this line, stability would result from collaboration, open communication and efficient coordination between involved actors. It is believed by one of the involved actors that the value chain could easily be restored because strong collaborative relationships have already been formed.

Transparency: An emerging value chain needs to build trust among the involved actors. This is underlined by several actors in the Spanish value chain and especially, the importance of building dialogue and relations already from an early stage. Formalised agreements on cooperation are being signed. In several interviews (upstream actors) it is pointed out that in reality no information on market prices are available at this early stage. In contrast, downstream actors claim that reliable information about markets, prices and competition would be available. Transparency is claimed to foster trust and informed decisions, it is explained by a company. There are current regulations that prohibit the extraction of CBD oil (cannabis oil) from **hemp.** Sustainable **construction materials** can be certified according to the green building standards BREEAM, LEED, Passivhaus; VERDE and WELL. These green standards are internationally recognized.

3.3. Sweden

Positioning the use case and its connection to marginal land: The Swedish use case is located in the Northern part of the country in the counties Norrbotten and Västerbotten. Due to the Northern location the crop growing season is short but with daylight most hours during farming season which gives special qualities of cultivated crops. Weather can be a bit unpredictable which demands a close stand by to time the work with planting and harvest. **Turnip rape** can play a crucial role in cultivation offering more variety and diversity good for soil health and also

help to generate value on unused farmland. This has an impact on the land's productivity, hence defines the marginality factor. The Swedish use case builds on an innovative **value chain for turnip rape as feedstock for biodiesel production targeted at farmers and some public transportation for self-support and preparedness of crises**. Municipalities are decision-makers for shifting to bio-fuels. Turnip rape has been cultivated in the area for more than a decade on ca. 160 hectares, with **demand for energy, animal feed and food oil as the main driver**. The regional public transportation authority has a strategic goal of achieving 80-100 % renewable and fossil-free fuels by 2035. The Swedish Government has reduced the requirement for bio-fuels from 30% inclusion rate in conventional diesel to now 6-7% inclusion rate, but **biodiesel from rape** is also used as a 100% biofuel and can be found at many gas stations in Sweden. In addition, turnip rapeseed oil is used as a **cooking oil** and the press cake as animal feed.

Coherence: A major trading company dealing in **bio-oils** for industrial applications (e.g., energy for paper factories) is considered to have a big influence on value chain coherence and can define prices, trading conditions and product specifications. The value chain for bio-oils depends on sufficient volumes and terminals to store and ship the oils to customers in Sweden and the Baltic Sea region. Traders can make a profit if volumes are big enough. The Public Transportation Authority plays a role for promoting the use of bio-fuels towards regional policy makers. The policy aspect is important for making decisions about **shifting to non-fossil fuels** and so, create a **demand for bio-oils including turnip rapeseed oil** but, it is not clarified what part should pay for the development. The possibility (for farmers and traders) to sell turnip rapeseed oil for bioenergy ensures access to a market, cash flow, and motivates a certain production volume. Some producers of turnip rapeseed oil (farmers) point to the vast distances which complicates the logistics of reaching the market. Compared to selling oils for energy, **turnip rapeseed oil for food** could claim a higher price as a local product.

Stability: The value chain for bio-oils (for energy purposes) depends on predictability, hence a certain level production of turnip rape oil year-on-year. In years of big production volumes, the oil from turnip rape seed can be mixed with other bio-oils and sold as **biofuels**. As volume plays a big role for value chain stability, it is important for the trader to have access to a consistent volume of bio-oils but in the counties Norrbotten and Västerbotten, the supply is a challenge as long as the cultivated area is small. Also, the trader can help with expanding the market to create more demand for turnip rape seed oil by procuring farmers' excessive crops in years with large harvest of turnip rape. The prices in the **market for bio-oils** correlates to prices for fossil oils and this can give fluctuations in the prices on bio-oils. In Sweden an economic support for fossil diesel paid to farmers is still a disadvantage for biofuels. Growers of turnip rapeseed explain that harvested volumes may vary over time due to weather conditions and lately, also insects. Some growers keep stock of seed to ensure next season's planting. The entry barriers to start cultivating turnip rapeseed are low. The wholesalers in the **food oil value chain** should take on a bigger responsibility for expanding the market for turnip rapeseed oil and strengthen collaboration with the local growers. Turnip rapeseed oil for food is sold to wholesalers, groceries and restaurants so, there are many distributors involved that can underpin the diversification in finding markets or re-starting an interrupted value chain.

Transparency: Bio-oils for energy are traded "on the spot" and at a daily price. A large trader has defined its own standards for bio-oil quality based on combustion outcome. Traders operate on "normal business terms" with

clients in the public and private sectors. Products for the **food market** must be labelled with bar codes – this is a requirement from retailers. Farmers have to comply with this requirement if they want their oils to be sold in the retail market. As the turnip rapeseed oils are from **organic farming systems**, the products are labelled with the Swedish organic certification KRAV. Farmers claim that retailers are difficult to work with and they do only little work to market the farmers' vegetable oils. One grower considers that a better collaboration among farmers or joint marketing efforts coordinated by an organisation could help to promote the turnip rapeseed oil by distributors. The public authority claims that it is easy to gather all interested parties but difficult to establish value chain collaboration because each party has an opinion about **fuels**, future and development. Also, municipalities lack knowledge about biofuels, electrical buses and local value chains.

3.4. Hungary

Positioning the Use-case and connection to marginal land: The Hungarian Use-case is centred round the production of woody biomass for **oyster mushroom** growth substrate. Straw has been the traditional feedstock for growth substrates but reduced quantities and higher prices on straw has motivated mushroom growers to look for other lignocellulosic biomasses. Alternative feedstocks are willow and sida as these species can grow on sandy soils. The Hungarian Use-case is located in the Southern Central plains of country in an area with increasing challenges stemming from desertification and poor sandy soils. The oyster mushrooms are sold in the Hungarian food market through a network of wholesalers. As part of the Use-case, innovative products will be developed from the **spent mushroom substrate** and from digestate stemming from biogas production. Certified organic enterprises that raise cattle for dairy and beef (Hungarian Grey cattle); produce arable crops, and have biogas production from agricultural side streams are also connected to the Use-case as the agricultural enterprises deliver **straw** for the mushroom growth substrate.

Coherence: From several interviews it is claimed that the **oyster mushroom** value chain is based on price competition. Farmers supply agricultural residues (straw) to oyster mushroom producers on long-term contracts and, mushrooms are sold to buyers in the Budapest wholesale market on contracts, too. This structure ensures a long-term perspective for the fresh oyster mushroom value chain. Due to increasing demand for agricultural residues, farmers have increased their prices to mushroom growers. Wholesalers distributing **oyster mushrooms** face limited competition in the market and can make a profit. Those companies that produce processed mushrooms, e.g. supplements, claim to have a profit margin due to the value added. The entry barriers to mushroom production are considered as significant as newcomers would require specific knowhow about the cultivation method and, the market for fresh mushrooms is highly competitive.

Stability: In the mushroom value chain, feedstock production and mushroom growing appear as an integrated activity. This is because **mushroom growers** produce their own growth substrate in order to reduce costs and to protect production knowhow. The integrated activity enables mushroom growers to pursue opportunities in other parts of the value chain, e.g., substrate production, to reduce risks occurring by mushroom production. Companies

that process mushrooms for e.g., food supplements as well as large mushroom growers have a significant size and dominate the market. Small and medium-sized mushroom growers point to the flexibility of smaller operations as important for business stability. The **value chain for biogas** (relates to the use of the spent growth substrate) can be influenced by the Ministry of Agriculture with requirements to environmental protection measures and from public institutions setting prices on green energy. The Use-case agricultural enterprises emphasize their self-sustaining nature as a key point for stability of their business.

Transparency: Feedstocks used for mushroom substrate are not subject to any quality standards and only checked for pesticide residues. **Growth substrate** and **fresh mushrooms** must comply with threshold values for pesticides as defined by the National Food Chain Safety Office. Also, manure-based products (e.g., fertilizers) must have a licence from the National Food Chain Safety Office to be allowed in the market. Sales of **oyster mushrooms** do not require any form of certification, so growers and buyers rely on personal relations to build trust about the mushroom quality. Biokontroll Hungaria Nonprofit Ltd. performs control of compliance with organic standards and provides information to producers. The European market for **mushrooms** and mushroom-based products is supplied by European producers but imported products from Asia claim a significant market share in the processed mushroom segment. One interview revealed that quality standards would be relevant to underpin the competitiveness of European products. There is a high level of competition in the European market for mushrooms and mushroom products. Mushroom growers and other involved actors can find information on the internet, trade forums, and from trading partners.

3.5. Germany

Positioning the Use-case and its connection to marginal land: The German use case is located in the federal state Brandenburg in the fenland (peatland) areas “Havelländisches Luch” and “Rhinluch”. These two fenland areas und some smaller areas cover in total 165.00 ha. The former wet region was drained 70 - 80 years ago and has been used up to now for farming (dairy production and arable crops). The German government has launched in 2020 a new strategy to re-wet parts of this area in order to protect the environment and wildlife, and to reduce CO_2 emissions. Re-wetting means that the groundwater level will be periodically or permanently raised to 10 cm below the surface in many grassland areas. Instead of grass for dairy cows, mainly typical paludiculture crops like reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), cat-tail (*Typha spec.*) and sedges (*Carex spec.*) grow on these fenlands. The new paludi species are not planted. In the German Use-case it remains to be seen which type of feedstock will develop by a natural process to what extent. The new plants are not or only partly suitable for animal feed. The re-wetted lands are very difficult to farm and farmers looking for other opportunities for using the land and generating income, hence the marginality of the land.

The German Use-case is currently at a stage where there is not yet an established value chain. There is a strong interest to find solutions for how to valorise the peat land while taking into account the special environment and the challenges that follow from working on wetlands. Organisations such as Association for Extensive Grassland

Management and the Forum Nature Brandenburg, and farmers' associations are actively taking part in the work to find new solutions through projects supported by national and EU funding, and in collaboration with research entities and local entrepreneurs. These combined efforts point to opportunities for **valorising the paludiculture for making e.g., biochar, pellets for bioenergy and, a number of new applications as for example fibres for substrates for green roofs, paper or animal bedding.** The German Use-case centres round a research institution that connects with farmers, nature conservation organisations, technology providers, and local industry.

Coherence: Experimental work is going on in a company and a research institute to develop a proper pre-treatment process for making fibres from the biomass. A feed producing company has facilities for processing biomass into pellets and is interested in using fibres from paludi culture for making **substrate for green roofs** (and animal bedding). In collaboration with the research institution, the company would experiment with the optimal formulation of the biomass blend and the processing with the aim arrive at a marketable high-value product. If tests are successful, the company would consider to invest in processing equipment and establish a value chain. So, appropriate pretreatment technology appears as an entry barrier for new actors. Interviews have revealed that several projects (with national funding) are working to formalise paludiculture in the Brandenburg area and especially, to raise the knowledge level about this cultivation method by farmers and landowners. It was also evident from interviews, that projects appeared to be working generally towards a common goal of preserving the landscape and promoting paludiculture but the collaboration across projects to push for value chain creation appeared as less of a priority. An agricultural college in the region has experience in producing and harvesting biomass and is willing to share this knowledge (most likely with biomass providers).

Stability: Feedstock from the fenlands is harvested by farmers in late summer, so there is a strong seasonal dimension to biomass availability. It is an open question whom should bear the costs and risks associated with a year-round provision of biomass; a set-up that involves biomass handling, transportation and, stock management. Currently the biomass is (mainly) for farmers' own use as there is no organised market for the gathered biomass, in essence because there is no industrial demand for this feedstock. A company claims that by establishing a "paludicultures brand" it might be possible to create a market for products such as **animal bedding** (for pets and horses) or green roof substrates. Also, one of the projects working on paludiculture has proposed to collaborate with companies making **construction materials** as a way to valorise the biomass. It is clear from more interviews that demand for a product made with fibres from paludiculture must be established, and that for example an industry association like the German Association for Building Greening (BUGG) could play an important role for stimulating demand.

Transparency: Several interviews with projects point to the fact that new value chains for valorising the paludiculture must be bottom-up, hence driven by the farmers. As there is very little, if any, information available on prices, costs or volumes for the biomass any actor's involvement would be limited. This is emphasized in interviews and that the result is a reduced motivation among the farmers to invest in the shaping of the value chains. Another impact stemming from the lack of information about value chains and products is that it is difficult for the agricultural college to contribute to improving biomass production and gathering – despite the college's interest in engaging in the value chain. To produce a product with a consistent quality, the fibres from paludiculture

needs be homogeneous by species and phenological stage at harvest. This requires value chain coordination the industrial processor explains. Quality standards for **green roof growing substrates** are defined by the association BUGG but there are no standards for paludi biomass quality. If demand for paludi biomass fibres were to be increased, the price on this feedstock is important as it competes with the use of wood fibres.

3.6. Argentina

Positioning the Use-case and connection to marginal land: The studied area of the Argentinian Use-case is a plain, covering 90,000 km2 with a humid and temperate climate. More than 60% of the soils of the Flooding Pampa are affected by water excess, together with an excess of salts. The grasslands of the more saline-alkaline soils have been greatly deteriorated and present bare soils; degraded grassland invaded by exotic plant species. The more salt and water affected areas were invaded by the *Lotus Tenuis*, a Mediterranean flowering legume. The limitations imposed by the landscape and soil characteristics induced further studies on how *Lotus Tenuis* could become a better valorised resource that would be widely available in the studied area. Currently, *Lotus Tenuis* is used in the form of grazing by dairy and breeding cattle, thus as a **forage resource**. There is no industrial valorisation of the plant. Additionally, it has been found that *Lotus Tenuis* improves the pollinating activity and the local production of honey.

The **studied area** is known for grass-based cattle farming to produce **meat and milk, and honey** production, thus a food value chain with products for the local, national and international markets. On the one hand, the Use-case explores the opportunities for maintaining and expanding food production (meat, dairy and honey) while **preserving the grassland ecosystem** including a wider use of *Lotus Tenuis* and, on the other, explores ideas about how to **valorise *Lotus Tenius* in new biobased products**. **Cattle farming** is based on many holdings of various scales. Dairy farmers in the region supply fresh milk to the largest dairy company in Argentina. The region is home to several slaughterhouses and meat processing facilities and the region is known as the "**Argentinian cradle for livestock production**" and offers all requirements for cattle farming including animal health control. Dairy farmers strive for quality milk by using high quality forage; beef farmers and beekeepers have made use of quality genetics. All producers emphasize the importance of grassland management, attention to reduced use of agrochemicals, and preservation of the ecosystem to ensure volumes of quality forage and high quality pasture land.

There are opportunities for inducing more value chains in the studied area: planting of camelina (oilseed) for **biofuels; biogas production**; more research about the *Lotus Tenuis* in cattle production to study how the plant impacts on methane emission from cattle as well as improvement in forage quality. The Argentinian Use-case presents Existing value chains (meat, dairy and honey) and Early-stage value chains (biofuels and biogas). For the report, we focus on the Existing value chains because of the data available.

Coherence: Interviews have revealed that infrastructural challenges (roads, lack of electrical grids, poor internet connections) are of major concerns for connecting farmers with the market. A beef farmer explained that he traded

the finished steers within the region, that is 600 km to the slaughterhouse and, a dairy farmer emphasizes the perishable nature of the product (fresh milk). The **cattle farming** sector is characterised by a high number of producers. In general, cattle farming is profitable (at least when considered over time), and the entry barriers for newcomers are low but requires significant investments in land, animals and technology. It is claimed in interview that greater association among the farmers would spur a better marketing of the products for example by promoting beef from grass-fed. It appears to be more challenging for milk farmers to earn a profit. Inclusion of new **beekeepers** is easy as beekeeping is seen as an alternative or supplement to cattle breeding as well as the benefits of pollinators for crop yields. Honey production is a traditional sector with low entry barriers for newcomers, and significant annual production of 500,000 tons Lotus honey in the studies area. Established beekeeping positions are respected by cattle farmers and, beekeepers are united in associations and production groups.

Stability: Slaughterhouses and meat processing companies are the ones that can influence supply and demand according to the prices paid to the farmers. The **meat** industry counts many companies so there are no major issues if one company would exit the value chain. From the long history of livestock farming and beekeeping in the region, it is evident that the beef and honey value chains have overcome extreme weather conditions and market fluctuations, yet appears resilient over time. The **dairy value chain** appears more challenged due to market volatility, competition and world trade issues. The respondent claims that Argentina has developed the national market well and now time has come to develop the sector to meet the global market challenges with more high-value products. Dairy companies and government have the power to push this growth agenda forward. Beekeepers could benefit from a joint effort to promote **Lotus honey** in export markets due to expected higher prices. Ministries have the power to determine honey prices and support the development of quality indices needed for differentiated marketing.

Transparency: Unexpected changes in tax regimes and regulations are considered by **beef and dairy farmers** to reduce the incentive to invest in the industry. There are mandatory requirements for annual animal vaccination and this system is fundamental to ensure transparency of animal ownership. The meat industry invests in traceability systems to enhance market access for the Argentinian beef. Slaughterhouses define the prices to beef farmers, and dairies pay the milk farmers according to a quality grading system based on the dairy's analysis of the delivered milk. Information about beef, milk and honey prices is widely available. For the dairy sector it is claimed that information about prices achieved by other value chain players than farmers would be facilitate the discussion about income distribution in the dairy sector. Establishing standard quality criteria would enhance the recognition of the **Lotus honey** and underpin the idea of a quality product from an ecological sustainable production. Market transparency for honey must be based on quality controls, certifications of origin and pollen analysis – thus similar structures as for meat and dairy products.

3.7. South Africa

Positioning the Use-case and its connection to marginal land: The Use-case in South Africa is coordinated by the University of Stellenbosch and addresses the issue of **land clearing from invasive tree species**, an issue that has

been high on the agenda by government, NGOs and land owners for 25 years. Some locations are identified by the government as *Strategic water source areas* and, such areas are targets for land clearing operations to protect water resources. Despite the fact that the Use-case is implemented in the Cape Province, it has relevance for the whole country. Land owners have a legal obligation to clear their land. Incentives (funding) for land clearing through tenders have been offered by national and provincial governments (e.g., programs like Working for Water or LandCare), municipalities and supported by NGOs. Such programs would typically fund post-removal activities, stockpiling or burning and hardly connect biomass users with biomass providers. Actors in **wood-based value chains** would regard such incentives as support for actions in a value chain; NGOs as an incentive to clear the land; and government as a social action to create jobs. So, who ends up paying for land clearing operations? These diverging views illustrate the challenges of the (under-funded) system. The latest government-initiated program has been evaluated as highly inefficient and working against market competition. The program was stopped in 2023, leaving the private sector in charge of developing tree-based value chains.

Two major issues characterise the public funded incentives: most have lacked sufficient funding for the planned actions and, in many cases, there were no plans for what to do with the wood after cutting down the trees. Even today there is a significant lack of coordination between the provision of wood from the invasive species and the entities that could make use of the biomass, thus a strong example of lack of coordination of supply and demand.

The South African production and demand for biomass (wood) is huge. Traditionally, local people have cut down **wood for fire, heat and, the making of charcoal**; hence mainly small-scale economic activities. Commercial-scale sawmills produce lumber, and the **wood industry provides materials for constructions, furniture, fencing poles and, wood chips for animal bedding. There is a bioenergy industry**, too. It has been reported that an international company could be interested in producing wood pellets from the invasive trees for exporting to the European market. The status of this venture is not clear.

The South African use-case is designed to investigate how new value chains could be shaped based on the large quantities of wood while taking into account socio-economic conditions, land clearing issues and, environmental impact. The South African Use-case investigates value chain opportunities and challenges through dialogue with diverse stakeholders from the public and private sectors. The key conclusions from these dialogues are summarised in the sections below.

Coherence: Typically, biomass users (e.g. **producers of lumber or pellets**) would take the initiative to source biomass, hence start a value chain. Small-scale operations tend to be more opportunistic, for example when biomass availability creates opportunity to collect and sell firewood. Landowners can engage in wood processing for own use, e.g., firewood. The main challenge of the wood-based value chain seems to be the sourcing of sufficient supplies of biomass, hence making the biomass available continuously at a good price where it is needed. Wood-based value chains have existed for a long time for example based on the processing of pine wood into e.g., animal bedding or planks. **Wood biomass** from pruning is also available so, additional volumes of biomass from invasive trees only enlarge the pool of biomass available. Entities with contracts on clearing land have an interest in leaving the biomass where it was cut down and, in addition, only carry out minor land restoration efforts (part of the contract). In contrast, market actors (processors of biomass) have an interest in sustainably sourced biomass of a

high quality (maybe certified) for the domestic and export markets. Due to previous unsuccessful initiatives by the public sector to support the shaping of post-harvest value chains, it is now considered that this is the responsibility of the private sector.

Stability: As businesses can make use of more types of wood there is some flexibility in the wood-based value chains. Also, some businesses can move their operations to other locations, for example companies that clear the land. In several interviews it is claimed that there is "plenty of biomass" and therefore no uncertainties on biomass availability. One interview with a landowner pointed to the long-term relationship (15 years) between the landowner and land clearing operator as an indicator for stability in the tree value chain. The wide **availability of biomass** is regarded by value chain actors as an asset because it enables flexibility in the supply chain. An important issue that is claimed in interviews to lead to conflicts among value chain actors is what to do after harvesting operations. Both biomass users and suppliers have an interest in keeping biomass costs low which translates into minimal post-harvest removal and land restoration costs. On the other side, environmental NGOs are concerned that private actors develop value chains without proper regulation/attention to sustainability issues. Such contrasting views on managing land clearing operations may impact on value chain stability.

Transparency: A key issue is the lack of reliable information about biomass availability and biomass quality and, this represents a major issue for the development and feasibility of **wood-based value chains**. Transparency is not always optimal in contracts between landowners, biomass suppliers and biomass users on e.g., prices. Biomass suppliers (contractors who cut down the trees) may pay the landowner for harvesting only high-quality wood whereas the landowner might expect payment for a full clearing of the trees. Some landowners and sawmills seek certification as FSC for the wood provided. There seems to be ca. 20 SMEs involved in the wood industry in the Stellenbosch area, hereof ca. 5 SMEs in the charcoal business. This indicates competition in the market but, as it is revealed in interviews, the SMEs seem to be operating in different segments of the market with different products. There seems to be a diversity of actors involved in the wood-based value chains, with lots of informal actors operating "under the radar" and formal ones that operate in a reliable manner. One obstacle is the unclear information about areas subject for land clearing because of unsecure (un-updated) maps.

3.8. Similarities and differences between the Use-case value chains

Based on the above description of the seven Use-cases, we present here aggregated findings across the Use-cases. Across the interviews from all Use-cases, it is a very clear point that Feedstock Producers depend on a market as only limited quantities are for own-use (e.g., firewood). It is also evident from interviews that feedstock producers do not create a market themselves, so the market has to be shaped by other actors in the value chain as for example biomass processors or manufacturers. An important finding is that Feedstock Producers can become market-oriented actors once they are offered a market. This was illustrated by Use-cases in South Africa (land clearing schemes), Sweden (government requirements for inclusion of bio-oils) and, Greece (entrepreneur sourcing biomass on contract). The German Use-case showed that farmers could be interested in becoming biomass producers if

more information would be available on costs, prices and markets. The Argentinian and Hungarian Use-cases showed how the feedstock is for own use in the agricultural sector.

Biomass needs to undergo some form of treatment before it can be used in an industrial process, for example extracting and processing of the hemp to make natural fibres. This positions the Biomass Processors at the centre of the value chain with an important role for connecting feedstock producers with users (manufacturing or the public sector). The Greek lavender oil producer and the Spanish processor of hemp and kenaf are both examples of this situation. Biomass Traders employ a similarly important role by procuring feedstock to secure volume that can be further traded to processors. This was explained in the Swedish value chain for turnip rape seed oil for bioenergy where a large trader was essential for connecting producers of turnip rape seed with bio-oil producers. The example from South Africa underlines this point: Connecting feedstock providers with users was complicated due to the lack of information and no central coordination of the value chain. The example from Germany illustrates how one entity (a company) could take the role of both Biomass Processor and Manufacturing by implementing the relevant processing technology, in this case to process feedstock from paludiculture for fibres that are used in substrates from green roofs. By taking up this role, the German company appears as a Key Actor in the value chain.

The Industrial Application segment produces products for the consumer market, for industrial applications and for the public sector (for example bioenergy). From interviews it was clear that companies in the Manufacturing segment were existing businesses that, in addition to their ongoing activities also had started to produce products made with the feedstocks from the Use-cases. For example, the Greek company in the wood industry was already producing MDF-boards; the Spanish company producing construction panels was already working with biomaterials, and Swedish companies in the bio-fuel industry would be engaged in making biofuels from other sources than turnip rape seed. The South African Use-case illustrates how wood from invasive trees becomes an additional source of biomass.

Finally, the Market segment is the key to profit for actors in the whole value chain hence, the Market plays an essential role for creating demand for the products from Manufacturing and subsequently, for the feedstock. The local markets appear as very important for food value chains (honey, mushrooms) but also for wood (firewood, pellets). On the other hand, the local markets were in interviews claimed to limit growth opportunities as it was evident for the lavender oils, the panels for the construction sector and, honey. The example from Sweden illustrates how a national market shaped by energy policies (inclusion rates for bio-oils in fuel) can be implemented in a regional scale. Also, the examples from Greece and South Africa showed how the public sector plays an important role for shaping a market for bioenergy: in South Africa through the land clearing funding scheme and in Greece through the supply of wood from state-owned forests.

4. Analysis of the critical factors for value chain performance

In this chapter we provide a cross-cutting analysis of the indicators characterizing the critical factors of value chain performance (refer to Figure 1), thus an analysis at an aggregated level of Use-case value chains. Based on the analysis, we delineate those indicators that appear to have the biggest impact on value chain performance and rank these indicators by Early-Stage, Emerging, and Existing value chains, respectively.

4.1. Understanding Coherence

Infrastructure: In a value chain context, infrastructure refers to the institutions, installations, framework conditions and, expertise that need to be in place to enable value chain functionality. Without proper infrastructure such as roads, electrical grids or internet, actors' access to markets and information are hampered. This was evident in the interviews from the Argentinian **food** value chain where farmers pointed to the need for improved roads and IT access to better connect with the market. Similarly, in South Africa, vast distances and poor roads caused major problems for connecting **wood** suppliers with biomass users. From interviews with Hungarian actors, it is underlined that better access to business development support and technological knowledge is relevant for accelerating value chain development. The need to draw on expertise is highlighted in the interview with the Greek **lavender** company. Here, it is claimed that all regional expertise including the private sector, clusters, government and university must work together with the lavender processors to define a common goal for the sector and its development.

Profit for all: All businesses strive to make a profit but not all businesses are in a position to shape their opportunities to make a profit. For example, **farmers** are dependent on the prices paid by processors such as slaughterhouses and dairies so, a situation that positions farmers as price-takers. Similarly, Swedish producers of **food grade turnip rape seed oil** find it difficult to claim higher prices from retailers. By joining forces farmers could gain a better bargaining position and potentially push the industry or retailers for higher prices, as evident in the interviews with farmers in Argentina and Sweden, and the Greek **honey** producer. In the Hungarian **mushroom** value chain, contractual relationships between providers of feedstock and mushroom growers, and between growers and wholesalers define the prices.

By offering producers a price for feedstock that otherwise would not have an economic value, a market is created for this type of biomass, e.g., agricultural residues. In South Africa, small holders could gather **biomass** for own use or small-scale businesses such as sales of firewood with the opportunity to gain a profit. It is very important to apply a long-term perspective when developing a market for biomass, as both feedstock providers and processors depend on the feedstock for generating income. In an early-stage value chain, as the Spanish and German Use-cases, it was

made clear that profit for all, especially farmers (here biomass providers), was critical for a new value chain to shape and develop. In the South African Use-case, it was revealed that uncertainties about what operations should be delivered even on contractual basis (e.g., post-harvest removals) created conflicts between biomass suppliers, land owners and biomass processors; thus, a conflict about profit.

Collaboration: In markets with few buyers and many smaller suppliers, as for example in the beef and dairy sectors, suppliers become price-takers and subject to the buyers' influence on prices, supply and demand. This is evident from the Hungarian and Argentinian Use-cases where **farmers** called for cooperatives or other collaborative organisations to be established in order to gain a better foothold in the market. In Sweden, growers of turnip rapeseed oil suggest collective marketing efforts to promote the oils in the food market – a suggestion that was also supported by a Greek **honey** producer. Buyers of biomass for processing, e.g., agricultural residues, can make use of contracts with farmers to secure volumes and prices and by this, build long-term collaboration and trust.

The Greek **lavender** value chain displays a situation where collaboration is currently not sufficient – particularly because this value chain seeks to define a common goal for the sector's development and, ultimately, achieve a quality seal for lavender products from the area. The German Use-case demonstrated another view on collaboration. Here, many projects were working on paludiculture and environmental management but with a low degree of collaboration targeted at knowledge exchange or establishing value chains.

Inclusion of new actors: New actors may join a value chain at any step from feedstock production to market however, some steps or value chains may have higher entry barriers for newcomers than other. From interviews with farmers in Argentina, Greece and Sweden it was claimed that the **entry barriers** for new cattle farmers, honey producers or growers of turnip rape seed were low. This was also evident in interview about lavender production in Greece and potentially also for hemp and kenaf growing in Spain. In contrast, the entry barriers to the oyster mushroom industry were considered as high because of the need for specialty knowhow about the cultivation. This indicates that there can be major differences between value chains in the same sector – food. Building a new plant to process biomass may require significant investments, technological knowhow and organisational skills. This indicates high entry barriers at this step of the value chain, particularly in situations when the value chain is developing because of concerns about whom to bear the risks of investing in this early-stage venture. The German Use-case underpins this finding. In contrast, for providers of biomass the entry barriers are much lower and may be regulated through agreements on volumes and qualities. This was evident from the Greek case of **processing agricultural residues** into pellets for feed and energy but also from the German Use-case and requirements for consistent biomass quality.

4.2. Understanding stability

Control of own operations: It follows from interviews with Hungarian value chain actors that a small and flexible operation is recommended for remaining in control of own operations in times of disruptions. Especially, the Hungarian agricultural enterprises pointed to the self-sustaining and circular nature of their operations as a key to survive. Also, Swedish farmers take action to **secure own operations**: they store seeds to be sure to have planting materials for next growing season, and make use of the turnip rapeseed oil for on-farm purposes (energy and feed). These examples demonstrate how value chain actors take control of own operations to sustain their business by mitigating risks and making use of available resources. The Greek **MDF-board** example also touched upon the control of own operation, but from another perspective. Here, the reduced volatility of wood prices from state-owned forests were mentioned as critical for managing own operations as the price predictability reduced risks.

Access to input: Companies, farmers and producers of biomass build their businesses around processing of certain types of biomasses with the intention of selling a product for a profit, thus indicating a requirement for a (continuous) access to input for processing. From the South African Use-case it was evident that the **continuous access to biomass (wood)** appeared as a major concern for biomass processors with the main issue being coordination between supplier and user. Access to input provides opportunities for entrepreneurial activity. This was also demonstrated in the South Africa Use-case. Here, small holders could gather biomass for own use or small-scale business activities. For an early-stage value chain the provision of biomass is essential to foster investments in processing infrastructure. The Spanish use-case showed that the involvement of the agricultural sector (farmer's cooperatives and seed producer) was important to foster the production of biomass (**hemp and kenaf**); also taking into consideration that the Spanish Use-case is motivated by agricultural challenges. Also, the German Use-case emphasized the need to find a solution for overcoming seasonality in the supply of **biomass from paludi culture** and, that this would raise the issues of whom to bear the costs and risks for biomass storage and transportation. The Hungarian **oyster mushroom** value chain makes use of contractual agreements to ensure access to feedstock (growth substrate). Similarly, the Greek company processing agricultural residues made contracts annually with farmers to secure biomass. In other value chains the access to input (biomass) is hampered because there is no connecting body. This was pointed out for the **Greek MDF-board** value chain and strongly underlined in the South African Use-case.

Access to market: Access to market refers to a business' legitimacy to sell in the sense of complying with regulations, and the actor's position in the market competition. Market expansion was high on the agenda for the Greek **lavender** case because of the need for a bigger (export) market to fetch better prices. Uniting forces among the lavender processors and diverse public sector actors was regarded as a pathway to achieve better market access for the lavender oils. The Spanish producer of **bio-based construction materials** plays an important role in the hemp value chain because of the company's extensive connection to the Spanish and European market, thus a situation with a growing market demand for biobased construction materials. The South African **wood industry** plays an important role for creating a market for wasted biomass that otherwise would have been burnt. The wood industry uses the biomass (from invasive trees) for e.g., biochar, pellets or firewood. In addition, opportunities for finding uses for the invasive trees in e.g., the wood industry creates motivation for more land clearing operations. From

the German Use-case it appeared important to demonstrate that there could be a market for products made from feedstock from paludiculture in order to create motivation for establishing value chains. The inclusion rate of **bio-oils** from e.g., turnip rape seed in biofuels was defined by the Swedish government hence, the market access appeared regulated by an authority. Interviews with Swedish Use-case actors underlined the fact that new rules on reduced inclusion rates were causing concern for the turnip rapeseed oil producers in the North of Sweden (Use-case location).

Key actor presence: From the Argentinian interviews it was revealed that there were many slaughterhouses in the region so farmers had more options for selling the cattle. This implies that should one meat processor disappear the beef value chain would not be disrupted. Swedish farmers pointed to a similar situation for selling the turnip rapeseed oil in the food market – **numerous distributors available**. On the other hand, with only one major dairy company to buy the milk, the Argentinian milk value chain would be in a much bigger risk of malfunctioning should this major company go out of business. A similar statement was given in interviews with Hungarian beef and dairy farmers and, it was evident in the Spanish and German use-cases. Here, it was pointed out that if the company processing the fibres or the company producing the construction materials or green roof substrates would **leave the chain, there would in reality not be a value chain any longer**. The major trading company is a key resource for enabling the Swedish bio-oils value chain and without this company, the bio-oils value chain would be challenged because of loss of market access for the growers. **Buyers** of bio-oils (e.g., energy companies) would change to other suppliers, so this part of the value chain appears less fragile.

Another perspective on key actor presence was given in the Greek MDF-board value chain: **The State**, as owner of more than 80% of Greek forests, is a key-actor in wood-based value chains because of the large supplies of biomass and the position as price-setter. The pricing system leads to foreseeable (less volatile) prices - thus reduced risks for the businesses involved. The **public sector** can appear as a lead actor for generating a market, as the example from Sweden shows. Here, the Public Transportation Authority together with municipalities were the core actors to create market demand for bio-fuels. Through funding schemes government can generate a market for certain products or operations as the example from South Africa showed. There, funding schemes aimed at land clearing operations played a major role for harvesting invasive trees and subsequently, the processing and trade in wood products. In the case of the Greek lavender oils, the **public sector was called upon to organise** the lavender value chain in terms of collaboration for better market access. Key elements in this strategy are a future local quality seal and increased trust in the product quality; an approach that is also relevant for the Greek *pseudoacacia* **honey** value chain.

4.3. Understanding Transparency

Regulations: A predictable regulatory environment is underlined in several Use-cases as fundamental for business development, value chains and investments. This was made clear in the Hungarian, Argentinian, Swedish, and Greek examples. In Sweden, reduced requirements for the inclusion rate of bio-fuels were considered to significantly

impact on demand for bio-fuels, thus the whole value chain for turnip rapeseed oil. In the Argentinian case the unpredictable tax regime was considered to impact on particularly farmers' willingness to invest. The Greek use-case emphasized the **many changes in regulations, tax regimes and government** that had taken place in recent years leading to lack of investments in processing facilities. Regulations may have a strong impact on trade, as demonstrated by the Greek MDF-board value chain. Here, it was pointed out that **regulations on traceability** were important for preventing illegal trade but also caused much bureaucracy in the value chain. On the other hand, regulations about traceability would enhance transparency in the Greek **honey and lavender oil** value chain. The trade in wood from the South African Use-case also pointed to **regulatory issues for preventing illegal wood trade**.

Access to information: Having information about prices is important for any producer to organise own production, sourcing and selling with an aim to make a profit and sustain the business over time. Some of the investigated value chains, e.g. the Argentinian one, revealed that **information about prices paid to farmers** by meat and dairy companies was widely available but also, that information about prices (or profits?) by other market actors would be appreciated by farmers. In contrast, lack of information (on prices paid to biomass providers) was emphasized in the German and Spanish use-cases with the main reason being the early-stage value chain. Information about markets and customer-ready products was claimed to be widely available in the Spanish Use-case. **The lack of reliable and updated information** appeared as critical in several interviews by the South African Use-case, leading to several difficulties: unregularly supplies of biomass and lack of data on where biomass is available; thus, situations that hamper the flow of goods in a value chain. In a **value chain with a high level of competition, information appears** as "less available to everybody" but existing among business partners, as demonstrated by the Hungarian mushroom value chain.

Trust among actors: Trust builds on **human relations** on the one side, and **information** (facts or fiction) on the other side. If trustworthy information is available to the buyer and seller, for example in the form of a quality graded payment scheme, the deal would probably be recognised by both actors as "**fair**". In situations when only one of the parties, e.g., the buyer has information about the quality of the product and therefore decides on the price, the seller may experience a reduced trust. This was explained in interviews with an Argentinian dairy farmer. Trust is also about building relationships and this connects with honesty and keeping **agreements**. This was underlined in interviews from the Spanish Use-case, emphasizing the need to have an **open and transparent dialogue** already from the value chain was beginning to form. In contrast, the South African Use-case illustrated how lack of trust between land owners and biomass suppliers led to conflicts about what post-harvest operations were to be performed – even in contractual agreements.

Certifications and quality standards: As with trust, quality may a vague notion be perceived by a customer or may rely on a defined standard. A **perceived quality** (in the sense of "product attribute") indicates the recognition a customer would have for a certain product, whereas a standard is based on a set of defined criteria and valid for a single product, a product range or, a whole industry. For example, agricultural residues, wood or feedstock from paludiculture would be of an expected quality defined by the company that would process the feedstock.

The **difference between quality and standard lie in the formality**. A standard requires a set of criteria, collaboration among the actors involved in the making of the product (i.e., the value chain actors) and that there is a system in

place to ensure **compliance** by all actors with the criteria that define the standard. The organic standard is a well-known example of an internationally recognised scheme with EU labels and national labels (e.g., KRAV in Sweden). There are several examples by the Use-case value chains of products that aspire to certain standards, or certifications, with the intention of **gaining market access and/or claiming higher prices**: the Argentinian Lotus honey; the Greek lavender oils and, the South African FSC-certified wood, and bio-based construction materials that are certified as Passivhaus, VERDE or WELL it was revealed from the Spanish Use-case.

Risk management: Risk management may refer to managing the risk of the business in economic terms, or **managing risk in relation to ensuring compliance with regulations.** An example of the latter is mushroom growers' compliance with regulations on pesticides in mushroom growth substrates as defined by Hungarian Food Chain Safety Office. Changes in EU regulations made it necessary for the Greek company in the lavender oil business to update the safety data for the products. This was done in collaboration with the University and the Region. Currently, the Spanish Use-case is focused on natural fibres but the cultivation of hemp creates an opportunity to produce CBD oil (cannabis oil). This substance is heavily regulated by the European authorities which significantly limits the opportunities for the Use-case to explore this avenue. The Spanish Use-case brought forward another view on risk management: Monopolistic market situation. This referred to the risk foreseen by biomass providers with access to only one entity for processing the biomass into natural fibres.

One approach to **managing own risk is to implement a self-sufficiency strategy** as evident by Swedish growers of turnip rape seed and the Hungarian farmers. In both examples the key issues were to reduce dependency on external actors, secure available resources and, cut down on costs. **Risk management** could well relate to the **income generating strategy** of a company, as explained by the Greek MDF-producer: If the biomass was not suitable for making MDF-boards, then it could be used for bioenergy; hence there would always be an opportunity for generating income from the biomass. Or, a strategy for diversifying input: South African wood processors claim that they can make use of pine, wood from pruning, and wood from invasive tree species and so, the businesses appear less dependent on one source of biomass.

4.4. Ranking of the indicators for Coherence, Stability and Transparency by value chain typology

From the analysis above, we have compiled an overview of the most important indicators of the critical factors for value chain performance, Table 2. We based our assessment on the typology of the value chain (Early-stage, Emerging and Existing) and importance of the factor defined as High, Medium or Low. The definition High refers to a very important factor for value chain performance, whereas Low refers to a factor with a lesser impact on value chain performance.

Table 2 The most important indicators for the critical factors by value chain typology

Critical factor	Indicator	Early-stage value chain	Emerging chain	Existing value chain	Comments
Coherence	Infrastructure	H	H	H	All businesses depend on access to roads, ports and IT and, support from an appropriate institutional framework
Coherence	Profit for all	L-H	M-H	H	Early-stage VC have less commercial activity whereas Existing VC depend on profit for all. Higher motivation for taking economic risks in Early-stage VC.
Stability	Access to market	M	H	H	Markets are fundamental for trade and making a profit. Early-stage VC still need to develop technology or product.
Stability	Access to input	M	H	M-H	Access to input fundamental for any producing entity. Early-stage VC still working on developing product or technology. Existing VC could easier change to new suppliers or alternative materials.
Stability	Key actor presence	H	H	M-H	Early-stage and Emerging VC depend on (one) key actor for the VC to grow. Existing VC may have more key actors in this or parallel VCs. Public sector as key actor more important in Early-stage and Emerging VC. Companies more important in Existing VC.

Transparency	Access to information	H	H	H	Any business needs access to information to navigate, to work towards profit, and to reduce risks.
Transparency	Risk management	H	H	H	Any business needs to manage risks to sustain the activity and work towards profit.

(IFAU assessment based on data from Use-case leaders and literature)

5. Identifying market-pull

In this chapter we first provide an overview of the products from the Use-cases, then we identify if certain attributes might have a positive impact on the demand for the Use-cases' products. This knowledge would help to identify market-pull for the industrial feedstocks provided by the Use-cases.

5.1. Use-cases' products and customers

The seven Use-cases produce or aim to produce **products for the consumer market, for industrial applications, and for the public sector**. Some of the Use-cases' products are already in the market, Table 3. The Hungarian oyster mushrooms, the Greek lavender oil, the beef and milk from Argentina and, the South African wood pellets are such examples. The turnip rape oil from Sweden is regarded as a product in development, and the MDF-boards from the Greek use-case will be trialled during the project. Finally, several of the Use-cases have ideas for what products could be produced so, products that are only available in lab-scale or as ideas. These products are far from the market – yet may have a commercial potential once introduced to the market. Examples of product ideas are fertilizer from the spent oyster mushroom substrate, animal bedding from feedstock from paludiculture, or products made with hemp and kenaf fibres.

Table 3 Overview of the Use-cases' products and customers

Use-case	Product in the market	Product in development or in trial	Product idea
Greece	Lavender oil. Customers: Consumers and industry MDF-boards made from wood; wood pellets for bioenergy. Customers: Industry, consumers	MDF-boards made with wood from *Pseudoacacia*. Customers: Industry	Certified lavender oil. Customers: Consumers and industry Honey from *pseudoacacia* blossoms. Customers: Consumers

Hungary	Fresh oyster mushrooms for food. Customers: Consumers	Spent mushroom substrate for animal feed; biogas digestate as organic fertilizer. Customers: Farmers	
Spain		Pre-fabricated panel with hemp and kenaf fibres. Customers: Industry	
Sweden	Turnip rape seed oil for food. Customers: Consumers	Press cake from oil pressing used as animal feed; Customers: Farmers Turnip rape seed oil for inclusion in bio-fuels. Customers: Industry	Glycerol for poultry feed or cosmetics. Customers: Industry (farmers)
Germany		Pellets for bioenergy. Customers: Farmers, industry, (consumers)	Green roof growth substrate. Customers: Industry Animal bedding. Customers: Farmers
Argentina	Milk, beef, honey. Customers: Industry and consumers		Certified production of grass-fed beef and Lotus honey. Customers: Industry and consumers
South Africa	Firewood, lumber, charcoal, pellets, wood chips. Customers: consumers, industry	Biochar (pellets). Customers: Landowners	

(Based on information from Use-case leaders).

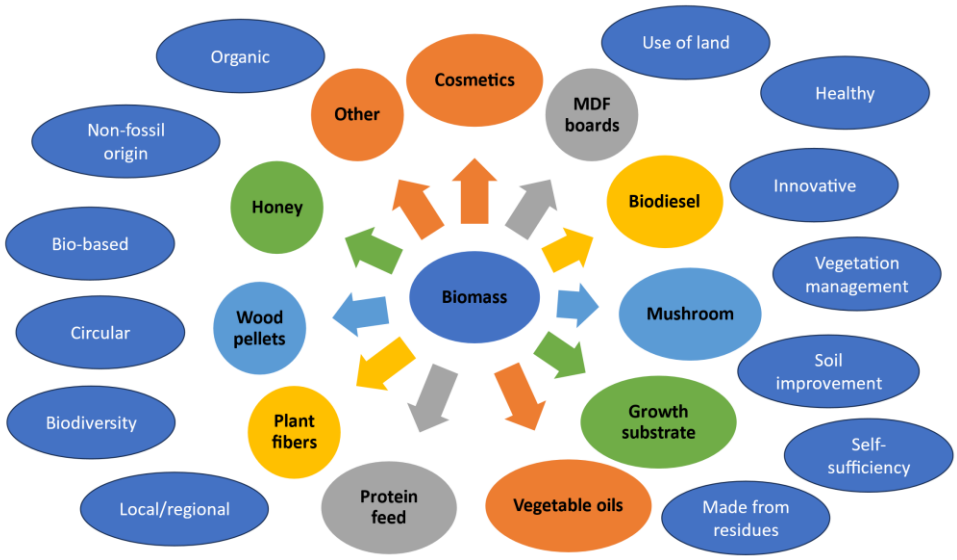
As presented in Table 3 above, the Use-case products are targeted at industry (either as processed biomass or use in diverse products, or that will be used by companies; farmers (in some cases for own-use), and consumers (food products).

5.2. Attributes for market pull

5.2.1. Attributes discussed by all focus groups

Attributes are quality characteristics that customers connect to a certain product, either as a tangible quality (e.g., soft, big or easy-to-open) or intangible. The latter refers to value-laden quality characteristics that are considered by a product and often in the form of perceived values. Examples are “local” or “handmade”. We explored a range of attributes selected from Glemnitz et al 2023 and from information provided by Use-case leaders, Figure 5. Some of the attributes are easy to understand, e.g., “healthy” or “organic” whereas many others are more complex, for example “made from residues” or “biodiversity”.

Figure 5 Collection of attributes to be explored in focus groups



In order to capture customers’ perception of attributes, Use-case leaders organised focus groups (refer to chapter 4). A key element in the focus groups was to discuss attributes that reflected biodiversity, as well as marginal land nature. Table 4 shows the attributes that were discussed by all focus groups.

Table 4 List of attributes that were investigated by all focus groups

Attribute	Comments from the focus groups
Preserves biodiversity	Positive opinion about the attribute. It is a very important attribute and relevant; a certification would be needed; all producers have a footprint on biodiversity. Turnip rape is good for pollinators – but the honey is not that good.
Produced with biomass from marginal land	Positive opinion about the attribute. It is a very relevant attribute, especially targeted at environmentally concerned consumers. Oil crops have a positive impact on soils.
The product contributes to restore nature	It is a very relevant attribute, especially targeted at environmentally concerned consumers.

From the Use-cases it was reported that the three above-listed attributes appeared relevant for products such as e.g., bio-oils, lavender oils and, MDF-boards. However, a common response across the Use-cases was that the above-listed attributes would be difficult to apply unless they were incorporated into a certification scheme. Also, it was reported, attributes that promoted the environment and nature would appear relevant to environmental-conscious consumers. It was further reported that the attribute "produced with biomass from marginal land" was too complex for consumers and would be difficult to apply for industrial products. A common reporting from most focus groups was that attributes appear most relevant for products targeted at the consumer market.

5.2.2. Comments about attributes and market-pull from Use-case focus groups

In the **Greek** Use-case, the *Pseudoacacia* wood would be blended with other types of lignocellulosic biomass to produce the MDF-boards and pellets; the main reason being to achieve certain chemical and physical properties of the end-product. Focus group participants state that products made with biomass from marginal land, here

Pseudoacacia wood, must be at least as good as similar products in the market, and if this would be the situation, then marketing work would be used to promote the new blended products to customers in industry. The lavender oils from the Greek Use-case cannot be certified as "organic" as the plantations are not certified. It was claimed in the focus group a certification such as "green" could be relevant to promote the lavender oils to the cosmetic industry. Table 5 shows the additional attributes discussed by the Greek focus group. A key conclusion was that, for attributes to have an impact on demand they would need to be certified in a formal way (i.e., appear as a certification) and that a single attribute would not lead to increased demand for the Use-case's products.

Table 5 Specific attributes discussed by the Greek focus group

Attribute	Comment
Helps the environment	The claim would not make the product (MDF-board) stand out as environmentally concerned consumers make up a small market segment.
Reduced environmental footprint	The attribute gives value if the new product can be produced in the same way and provide the same safety for use compared to existing products
From marginal lands	The claim would not make the product (MDF-board) stand out.
Green	There needs to be a formal certification for this attribute to work. The industry needs to be convinced that the product can be marketed to the end-user with the same quality characteristics. "Green" must be promoted purely by the industry on its own initiative and would be considered most relevant if logistics or packaging also collaborates on this attribute.

The **Spanish** Use-case centres round prefabricated panels made with hemp and kenaf fibres. This new product complies with the technical building code. The new prefabricated panels are regarded by the producer as a sustainable, biodegradable and ecological product, with the core customer group being the construction sector including companies building modular houses for the consumer. The new product would feed into an existing market and offer improvement in terms of time, cost, lightness and sustainability. The Spanish focus group agreed

that new panels would appear as a sustainable and ecological product. Also, the group agreed that the new product would stimulate activities in rural areas and the seed innovation would improve the hemp and kenaf production. A key conclusion was that the cultivation of hemp would help restore nature in the region because of crop rotations and soil improvement.

The focus group in **Hungary** explored two new products: a feed product made from heat-treated spent mushroom substrate (Pleurofeed) and digestate from biogas production to be used as fertilizer (Pleuroferm). The key customers for the first product are farmers with livestock including producers of aquaculture and insects, and for the second product farmers with arable crops and horticultural production. The feed product's advantages are that the oyster mushroom breaks down the lignin and therefore the digestibility of the feed increases compared to silage and, if the feed is used in aquaculture (carp production), the growth of zooplankton increases and this helps to reduce costs for fish feed. The fertilizer can be applied on fields and provides a high level of nutrients. Compared to synthetic fertilizers, the Pleuroferm is considered as an organic product (requires certification as such) and contributes to reduce the demand for imported rock phosphate. Both the feed and fertilizer products are in development so the focus group discussion addressed issues about the products' competitive advantages and further development, Table 6.

Table 6 Key issues discussed by the Hungarian focus group

Product	Attribute	Comment
Pleurofeed	Availability during critical seasons (drought or winter)	Mushroom production is a year-round activity and can provide feed on a continuous basis. Mushroom production capacity is currently the limiting factor.
Pleurofeed	Storability and handling	Spent oyster mushroom blocks are easy to store and handle (blocks of 16-18 kg) compared to silage.
Pleurofeed	Nutrition	Spent oyster mushroom blocks have higher crude protein and better digestibility than straw.
Pleuroferm	Chemical-physical properties	Dry matter, organic matter and nutrients are important for the customers (farmers)

Pleuroferm	Formulation, granules or pellets	Finding the right formulation is key to improve the value and competitiveness of the organic fertilizer
Pleuroferm	Question about possible organic certification	Biogas digestate is considered a non-agricultural, non-hazardous waste product. Using the digestate on fields requires a soil protection plan and authorization by county government. Digestate could apply for organic certification.

The focus group organised by the **Swedish** Use-case discussed about three products: turnip rape seed oil for biofuels, the press cake from oil pressing to be used as animal feed and, glycerol that could be used in biogas production or for cosmetics. Biodiesel appears to show the largest market demand in quantitative terms but there are many challenges to solve before a value chain from field to vehicle could be established. Participants pointed to a decreasing market for biofuels because of changes in regulations about inclusion rates in diesel and issues of the price for biofuels compared to fossil-based diesel. Furthermore, it was stated that farmers might be motivated to engage in the production of biofuels if farmers could make use of the press cake for feed and the oil as fuel for vehicles. Farmers at the focus group mentioned that the press cake could have a high oil content and this had a negative impact on the cow's digestion. Alternatively, farmers could use a compound feed made with the press cakes and supplied by a feed company. The market opportunities for glycerol needs to be investigated further. The main conclusions for three products are that, more knowledge is needed by producers and end-users for the turnip rape seed value chain to become more and wider established and, that profitability appears to be a major hampering factor for a wider demand for both the biofuel and the turnip rapeseed oil (for food).

The Use-case in **Argentina** provided some findings about producers' perceptions of quality. The discussions addressed how to articulate "quality" in the context of grassland and the plant species *Lotus tenuis*. This plant has an important role in the local ecosystem as the plant enhances the nutritional value and quantity of forage to be harvested and, provides nectar for pollinators. So, the plant is also important in the local honey production. The most important attributes mentioned in the discussions were "agro-ecological" and "natural eco-system". These attributes could be used for the lotus honey but potentially also for beef produced from cattle grazing on grasslands rich in *Lotus tenuis*.

5.3. Attributes and market-pull for industrial feedstock

From the focus group results it is evident that attributes such as "produced with biomass from marginal land"; "preserves biodiversity" or "the product helps to restore marginal land" would not stimulate a demand for industrial

feedstock produced on marginal land. The main reason for this result is that the mentioned attributes are complicated to use in a market communication targeted at consumers. It was also clear that the mentioned attributes did not appear relevant for any of the products targeting the public sector (bio-oils in Sweden or bioenergy in Greece). It might be that the South African land clearing scheme could make use of attributes refined to frame the environmental impact of the invasive tree species but we have no empirical evidence for this assumption.

The Use-cases provide a range of feedstocks: Wood, fibrous materials (grasses, hemp, kenaf), oil crops (lavender oil, turnip rapeseed oil), and forage crops from diverse typologies of marginal land. These feedstocks are used to make products for the consumer market, industrial use, and the public sector. Based on the results from the focus groups, the Use-case interviews, and desk research we draw conclusions about the relevance of attributes for creating market-pull for feedstock from marginal land, Figure 6.

Figure 6 Relevance of attributes for creating market-pull for feedstock

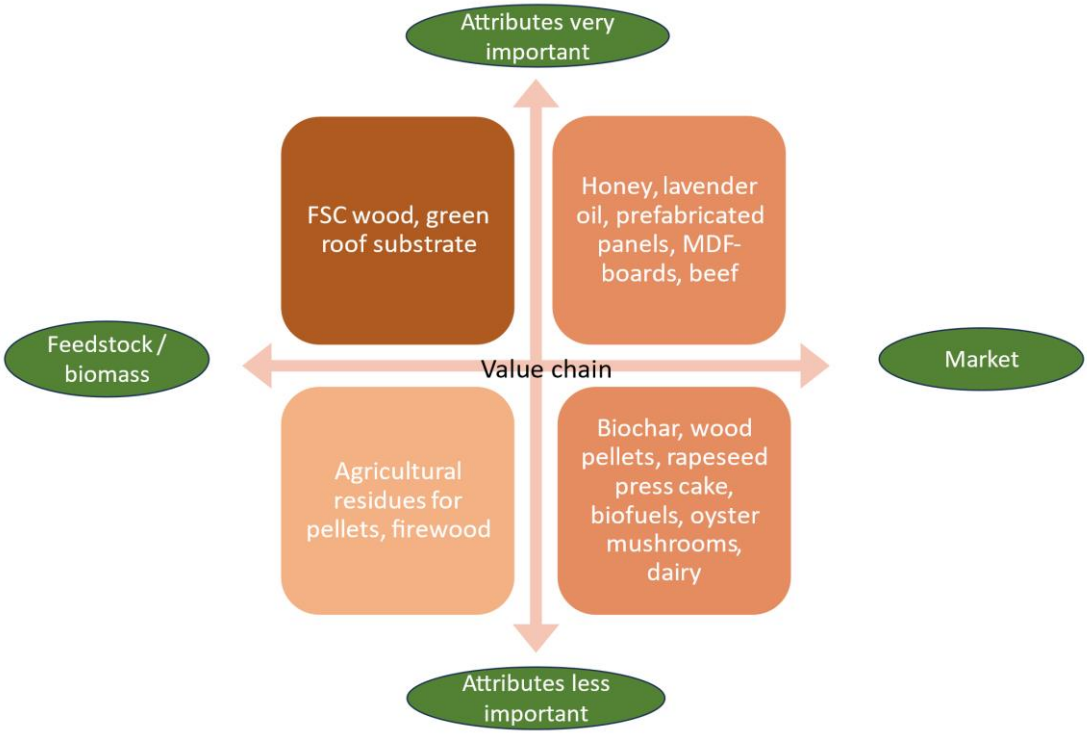


Figure 6 shows that attributes are the most relevant to use for products that are in the market and targeted at mainly consumers, secondly products for the industrial use with consumers as the final users. An example of the latter is the MDF-boards from Greece. Here, it was explained that only environmentally-concerned consumers might demand MDF-boards made with feedstock from marginal land, and that this market segment would be quite limited.

Respondents from focus groups concluded that market-pull for feedstock that would be used in agricultural productions (forage crops, growth substrates for mushrooms), press cake for animal feed would not to be stimulated by the use of the attributes referring to biodiversity or marginal land. This conclusion implies that demand for feedstock for agricultural use is driven by other factors such as availability, transportation and prices.

One finding from the South African Use-case is that demand for sustainably harvesting of invasive trees could be supported by the use of the certification scheme FSC. A similar finding was also evident from the German Use-case for the green roof substrate. These two examples show how a certification targeted at the feedstock production (wood or grasses) could create value through the whole value chain. The key to this success is that the mentioned certification scheme builds on transparency and traceability from feedstock production to the final market.

The low importance of attributes was evident from the value chains of wood pellets, firewood and agricultural residues. These value chains were characterised as solutions to get paid for an (otherwise) unused quantity of feedstock. However, these value chains well support the above findings that attributes are relevant for creating market-pull in the consumer market, and not in the market for biomasses or feedstocks. The market-pull for industrial feedstock stems from availability, specifications to quality and especially price including costs for transportation and handling.

6. Pulling the report together

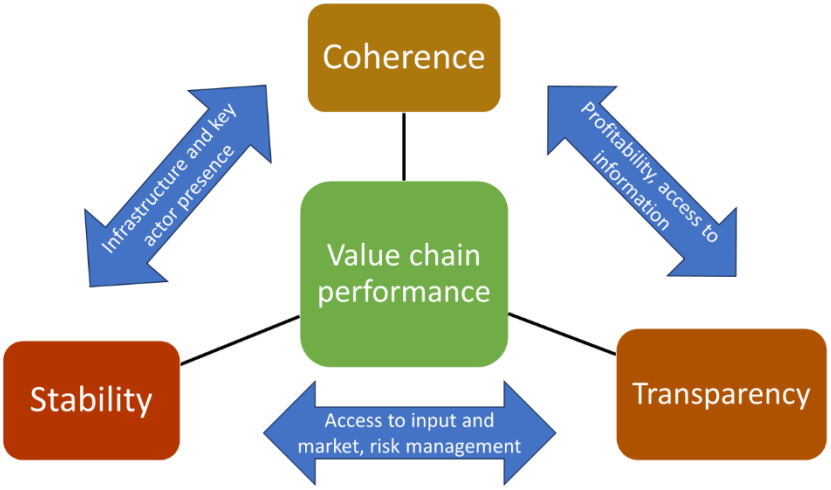
6.1. Discussion

In this report, we have presented the value chains from seven Use-cases in the MarginUP! project and analysed critical factors (coherence, stability and transparency) for the performance of these value chains. Our scope was to identify the critical factors and analyse their interplay so we could get an understanding of value chain performance. It was not the aim to point to specific value chains with a high performance as this depends on the value chain context as much as the value chain. We have also explored how attributes might impact on market-pull for industrial feedstock in the Use-case value chains. Our analysis is purely indicative and based on first-hand information provided by the Use-cases, deliverables in our project and, from desk research. All our results are provided at an aggregated level with examples from Use-cases to illustrate main points.

The value chains occurring by the seven Use-cases are very diverse in their development status, involved actors, the feedstock used and, the products delivered. Furthermore, the Use-cases work with different approaches to what defines "marginal land" in their specific case however, a commonality across the Use-cases' approach is that marginal land is land that is not good enough for a proper arable crop. The production of feedstocks is regarded as an alternative way of using this land for improving the soil quality, for turning a profit, or for land restoration. It is also important to keep in mind that the Use-cases are motivated by diverse conditions: some Use-cases are motivated by farmers and landowners' need for an income, others by the opportunity to use the new feedstock in existing productions, and other cases are motivated by regulations or schemes defined by the public sector. Despite their vast differences, a central commonality of the Use-cases is the interest in (and need for) **using marginal land in a new way and, this spurs the development of new value chains based on feedstock from these lands.**

In the report we have investigated value chains that are at a very Early-Stage of their development (for example in Spain and Germany), value chains that are Emerging (MDF-boards in Greece and bio-oils in Sweden), and Existing value chains like the Hungarian mushroom example and the Greek lavender oils. Based on the analysis in the report, we can conclude that there is no one solution as to how the three critical factors Coherence, Stability and Transparency should materialise for a value chain to demonstrate performance. Rather, **all three critical factors must appear to enable a specific value chain to grow, expand and diversify (i.e. demonstrate value chain performance) but, the appearance or materialisation of the critical factors vary according to the development status of the value chain, Figure 7**.

Figure 7 The mechanisms of value chain performance



A value chain is in its nature a structure building of coherence and collaboration to enable the flow of goods, services and money. Following this, any business would engage in a value chain with a motivation of making a profit – if this would not be possible there would be no motivation to engage. Therefore, profitability for all actors is a fundamental requirement to sustain and expand a value chain as demonstrated particularly by Existing value chains. Early-Stage value chains tend to be driven by entrepreneurs and research and, the outlook for making a profit in the future may be accepted at this stage. Coordination and ease of moving goods is import for any business transaction including sales and transportation of feedstock, or the moving of finished goods to a customer. All Use-cases pointed to good infrastructure and a predictable and transparent regulatory environment as very important factors for any value chain.

Several of the Use-cases' value chains depend on **key actor presence,** for example in the market segment or for providing the technology needed to process the feedstock or make the final product. This actor is considered as a key actor in the value chain. The Use-cases showed that key actor presence was important for supporting the development of the value chain. For example, the Spanish processor of feedstock to make natural fibres was clearly important for connecting feedstock production with market access. Similarly, the value chain by the German Use-case would build on the company providing the technology to process the biomass into substrates for green roofs. Without this technology and understanding of market opportunities, the value chain by the German Use-case would be challenged.

Feedstock availability can spur entrepreneurship. This was evident by the Hungarian Use-case with the decision to plant sida and willow to compensate for lack of straw for the growth substrate for oyster mushrooms. The Hungarian Use-case is working towards to the next step of entrepreneurship which is the development of new

products based on using the spent mushroom substrate for a feed product and biogas digestate for an organic fertilizer. The Greek Use-case pointed to entrepreneurship: the local cluster of lavender oil producers could work together towards obtaining a quality certification and subsequently target larger markets with higher prices. Similarly, producers of honey in the Argentinian Use-case were considering a certification for honey from Lotus Tenuis due to the renowned quality of the product. The three examples demonstrate how value chains can provide opportunities for diversification and growth.

In contrast, the example from South Africa clearly showed an abundance of feedstock (invasive tree species) being available to market actors but lack of information about where to harvest the trees significantly hampered the development of efficient value chains. The Use-case from Germany also pointed to the challenges of coordinating feedstock production in terms of compensating for seasonality and transparency in prices and costs for the feedstock produced. Also, the German Use-case pointed to an important issue: what actor should bear the risks and costs associated with feedstock handling and storage? This issue was implicitly touched upon in the South African Use-case where disputes were common despite agreements about harvest services were defined in written contracts. For Early-Stage value chains the issues of risks and costs need to be identified and discussed to ensure transparent collaboration and involvement of relevant actors for e.g., feedstock gathering or coordination of feedstock supply. Without considering **issues of logistics and coordination** all value chains, but particularly Early-Stage value chains will face difficulties in the development and scaling up process.

Our analysis has shown that a market is fundamental for the value chain to develop and grow and that it is the access to market that enables the value chain actors to generate an income. Without a market there is no value chain. This may complicate the starting of a new value chain, for example the use feedstock for a new product or an emerging market. The Swedish example demonstrates how the public sector can create a market for bio-oils and how this demand may impact demand for turnip rapeseed oil. Also, the example from Sweden clearly presents the sensitivity of the new value chain to changing regulations, here a reduced requirement for the inclusion of bio-oils in diesel.

The Spanish Use-case demonstrates how market-pull could stimulate demand for feedstock. The cultivation of hemp and kenaf was motivated by soil conditions. But, because of demand for natural fibres in the construction industry, a new value chain can be shaped and create a market-pull for the hemp and kenaf crops. Other Use-cases have shown a different approach to creating market-pull for feedstock: In the Greek case about *pseudoacacia* wood for MDF-boards, the supply of this feedstock becomes an additional source of feedstock for the company. The reason being that the company already produces MDF-boards from wood and with a growing demand for these boards, the company could make good use of the *pseudoacacia* wood. In the Hungarian Use-case, the planting of willow and sida trees was motivated by a reduced supply of biomass to produce growth substrate for oyster mushrooms and, the new plantations could be harvested every year to produce the needed lignocellulosic-rich growth substrate. Therefore, we argue that **a market is fundamental for creating market-pull for feedstock from marginal lands but, the market appears in diverse formats**: local, international, regional, but also as for own use. The essence is that **there needs to an economic motivation to create demand for the specific type of feedstock.**

Most of the products from the Use-cases are targeted at industrial customers or professional users: Producers of MDF-boards and prefabricated panels, processors of lavender oils and turnip rapeseed oil, producers in the wood industry and, the bioenergy and food sectors. We should also include farmers in this category. Professional users are known for basing their procurement on technical specifications, quantity, security of supplies and, price. This is in contrast to consumers whom are more inclined to consider value-laden attributes in their decisions about buying a certain product. This came clear from our analysis about attributes. We found that attributes cannot be too advanced as this would complicate the communication. Attributes like "preserves biodiversity" or "produced with feedstock from marginal land" could trigger environmental-concerned consumers' interest but the use of these attributes would be difficult without a certification. A key finding is that attributes touching upon green, environmental, biodiversity or sustainable production might be relevant for consumer-ready products but not for products targeted at the professional market. Therefore, **we do not consider attributes as the relevant vehicle for creating market-pull for industrial feedstock from marginal land**. Another learning from the focus groups was that market-pull for products such as bioenergy, biofuel, oil press cake, milk or firewood would not come from using the above-mentioned attributes. Rather, market-pull for these products would be in the hand of diverse market actors from the public and private sectors.

6.2. Implications of results

6.2.1. Implications of results for development of the Use-cases

It is the intention that the findings from the report-at-hand (D6.1) would be used to carry out research about the economics and market potential for Use-cases' products (T6.2); support the exploitation of the business opportunities identified (T6.4); provide input to policy recommendations for stimulating feedstock production on marginal land (T5.3 and T6.3). It is further the intention, that the results may support the development and scaling up of the Use-cases.

In more details we find that the results achieved in the report could be useful for strengthening the development of the Use-cases by:

- Encouraging the Use-cases to build more connections to actors in the Market segment by starting or expanding a dialogue to learn more about market requirements as well as strengthening the knowledge about customers' expectations to the quality of feedstock delivered. The Market dialogue could involve e.g., agencies working with certification schemes, companies that provide processing technologies and most importantly, new/additional potential businesses in the Industrial Application segment. Our report has documented that Industrial Applications is the most important segment to work with given the value chains defined in the MarginUp project.

- Consider the role of the feedstock in the value chains concerned. This implies to recognize whether the feedstock would be integrated into an existing biomass for a defined process (for example MDF boards),

the feedstock would be required for a self-sustaining purpose (examples from Hungary and Sweden), or the feedstock would enable a new value chain to develop (example from Germany). Based on such considerations, the Use-case can identify key actors to connect with for progressing the Use-case.

- Our research has pointed to challenges of coordinating the supply of feedstock with regards to quantities available, seasonality issues, and where the feedstock is to be found. It is recommended to work strategically in all Use-case to identify solutions for a better coordination of feedstock provision – also for Early-stage Use-cases.

- The public sector plays an important role for supply of feedstock and market demand for bio-based products. This was shown by the Use-cases in South Africa, Sweden and Greece. Use-cases are encouraged to map actors in the public sector to identify those actors that could create demand, promote feedstock provision and shape the regulatory framework to support the specific cause of the Use-case. Public sector entities could be identified at national, regional, local (e.g. municipalities), and EU levels.

- It is further recommended that Use-cases work strategically with the development of their stakeholder networks. The issue is that the stakeholder network (or key actors to collaborate with) should be adapted to the development status of the value chain. In short: an Early-stage value chain has more need for collaboration with the public sector and researchers than an Existing value chain, and Emerging value chains depend on key actors and entrepreneurship to underpin the development of this category of value chains.

- The value chains analysed in the report show the status as per today but, the overall intention would be to progress these value chains in the future. It is encouraged to already at the current stage to consider how the value chains could become expanded in spatial, volumes and economic terms. Such considerations should not be postponed but better integrated in the development work by each actor and the value chain. In the end this would foster new ideas and partnerships, and shorten time to market.

6.2.2. Implications of results for the MarginUp! project

In this report we have worked with the seven Use-cases in a parallel approach but the findings at the aggregated level would be relevant for a larger audience in the Use-case countries, other EU countries, and internationally. It is recommended at this stage of the project to apply a more strategic approach to identify potential locations or conditions where the report's results could be applied – preferably in a "cocktail" including results from e.g. WP1, WP3 and WP5. The strategic approach could be implemented by connecting with representatives of potential locations for similar value chains, or by working together with regions where similar value chains as proposed by the Use-cases are already in operation. The latter approach could provide the Use-cases with valuable first-hand experience, inspiration and potential market contacts.

Given the objective of MarginUp to promote industrial feedstock from marginal lands there is a strong element of land restoration, soil quality, biodiversity and environmental issues. Findings about such topics could well be

gathered from the project and provided to government at more governance levels and NGOs to strategically support policy work about the environment. Another important policy dimension relates to the supportive framework underpinning bio-based value chains. Here, it is recommended to compile key findings about value chains' requirements for support at diverse development stages.

As an outlook, these required measures and recommended future actions will be taken up in the upcoming work of the MarginUp! project, among other things, such as the policy recommendations based on strategies and roadmaps developed in a bottom-up workshop approach. Other expected results of the project are a comprehensive economic, ecological and social assessment of the value chains and the addition of the business and business environment perspective to the analysis. The networking of local activities with initiatives in other localities and regions is also expected to be an important contribution of the project in terms of the exchange and replication of results.

7. Concluding remarks

Our analysis has demonstrated that, the value chains by the Use-cases are highly diverse and show potential for further development. This is relevant for all Use-cases. New ideas from entrepreneurial actors, external conditions like new markets or favourable regulations, technology-breakthrough, access to new or more feedstock or, any other driver would in the perfect world create opportunities for the actors involved in the specific value chain. Hence, the value chain would grow, expand and diversify. This would be a perfect example of value chain performance. With the findings provided in the report we hope that diverse value chain actors from the public and private sectors would find inspiration to engage in the development of value chains based on feedstock from marginal lands.

8. Selected references

Engelbrecht K. (2023): Stakeholder analysis and map for all demo cases. D5.1 in HE-project Raising the bio-based industrial feedstock capacity of Marginal Lands; MARGIN-UP!

European Commission, Directorate-General for Research and Innovation (2018): A sustainable bioeconomy for Europe – Strengthening the connection between economy, society and the environment. Updated bioeconomy strategy. DG Research and Innovation https://data.europa.eu/doi/10.2777/792130

Hamann K. et al (2021): Flexible integration of GO-GRASS Demo supply chain components. D6.2 in H2020 project Grass-based circular business models for rural agri-food value chains; GO-GRASS

Hamann K et al (2021): Report on key value chain components from Go-Grass Demo cases. D6.1 in H2020 project Grass-based circular business models for rural agri-food value chains; GO-GRASS

Hamann et al, 2019. SDIs (Sustainable Development Indicators) for Quality Chains. D4.5 in H2020 project Transition Pathways to sustainable legume-based systems in Europe; TRUE.

Glemnitz M. at al (2023): Regionally adapted biodiversity indicator system. D2.1 in HE-project Raising the bio-based industrial feedstock capacity of Marginal Lands; MARGIN-UP!

Olsson J. et al (2023): Available marginal lands maps with relevant stakeholders. D1.1 in HE-project Raising the bio-based industrial feedstock capacity of Marginal Lands; MARGIN-UP!

Paulrud S. et al (2023): Report of the analysis of the specific components of Use-Cases. D3.1. HE-project Raising the bio-based industrial feedstock capacity of Marginal Lands; MARGIN-UP!

9. Annexes

9.1. Questionnaire for interview about value chain performance

Introduction

Q1 How would you describe the role of your organisation in the value chain?

Q2 For how long time has your organisation been involved in this value chain?

Q3 In what way did your organisation contribute to starting or shaping this value chain?

Exploring coherence, stability and transparency

Q4 In your own words, how would you explain *"coherence"* in your value chain?

Q4a Supporting question: How do you perceive the possibilities for the involved value chain actors to develop their business (because of this value chain)?

Q4b Supporting question: Are there any missing links (e.g., infrastructure, certain organisations, other) in the value chain?

Q4c Supporting question: How would you assess the possibilities for all involved actors to make a profit?

Q5 In your own words, how would you explain *"stability"* for your value chain?

Q5a Supporting question: What is the most important factor for keeping this value chain together?

Q5b Supporting question: What organisation in the value chain has the power to influence supply and demand?

Q5c Supporting question: How easy would you say it would be for new actors to engage in the value chain?

Q5d Supporting question: If the value chain were to be interrupted (because of e.g., seasonality, close of a key actor, other), how difficult do you think it would be to restore the value chain?

Q6 In your own words, how would you explain "transparency" for your value chain?

Q6a Supporting question: How would you describe value chain actors' access to information about the value chain, e.g., about markets, prices, competition?

Q6b Supporting question: How would you describe the trading conditions in this value chain? (e.g., fair trading conditions for all parties)

Q6c Supporting question: Do you know of any standards or certifications that impact on this value chain?

Q6d Supporting question: How would you assess the relations between actors in this value chain?

Exploring value chain performance

Q7: What would you say were important conflicting issues in this value chain?

Q8: What do you consider as the main challenges for expanding your operations in the value chain?

Q9: What do you consider as the main opportunities for expanding your operations in the value chain?

Q10: As a last question, how would you describe, in your own words, the *"performance"* of the value chain we have discussed?

End of interview

9.2. Procedure for Use-case focus groups

Facilitator briefly presents and explains the 1-2 most important products resulting from your use case (what is the product, what kind of biomass is used for the product, what can the product be used for and, what is the innovation). To get the discussion started, ask Q1:

Q1: Whom, would you say, are/would be the customers for this innovative product? The facilitator/use case leader encourages all participants to give their views. The facilitator could help the discussion (especially at an early stage of the meeting) by asking supporting questions such as:

Where do you think we could find customers for this product? In the local area, regionally, export markets?

Do you think there is a market for this product?

Q2: What makes this MarginUp product relevant for the customer compared to existing solutions?

Why is the product more relevant for this customer group compared to another customer group?

Why is this product more relevant than existing solutions (such as)?

The facilitator captures the answers and views from the participants and encourages participants to reflect on the statements other participants have brought forward. The facilitator decides if the procedure is to be repeated for the next product, or both products are discussed at the same time. Next, the facilitator shows a selection of attributes to inspire discussion, and explains "attribute" if relevant. The facilitator takes the first product and asks the participants:

Q3: For this product, what attributes/quality characteristics do you think are important for the customers we identified previously? The facilitator encourages all participants to give their views. Keep in mind that different customer groups may have different preferences for attributes. This is what we want to explore.

Q4: What is your opinion about these attributes: "preserves biodiversity"; "produced with biomass from marginal land"; "the product contributes to restoring nature"? The Q4 is intended to particularly explore attributes connected with marginal land and biodiversity. Please motivate your participants to give their views on these attributes.

Q5: What is your opinion about market demand for this product? Do you think the selected attributes would stimulate market demand? Why/not? The Q5 is used for capturing remaining views about market demand, customers and quality characteristics.

Wrap-up, thank the participants and close the meeting.