Master's thesis

NTNU
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Department of Geography

Fredrik Asche Kaada

A hybrid systemic approach to scaling up regenerative agriculture in syntropic conditions in Portugal

Master's thesis in Master of Science in Innovation, Entrepreneurship and Society
Supervisor: Alexander Dodge
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Abstract

In the past and on a continuous path today, traditional farming uses heavy portions of synthetic fertilisers to provide an infinite food supply. However, that is not sustainable since they destroy the topsoil. Regenerative agriculture (RA) builds robustness and resilience by mimicking nature and sequestering carbon simultaneously. This practice has led to an increase in nutrition and biodiversity compared to traditional monoculture operations. Two field trips were accomplished to reNature's HQ in Amsterdam and on-site in a rural area outside Lisbon, Portugal.

This thesis presents an exploratory case study of the Alentejo region of Portugal. Using a systematic approach, I examine a farm 1 1/2 hours northeast to identify barriers, enablers, and drivers for scaling up the project, focusing on environmental and social factors. This issue involves many local, national, and EU stakeholders. Furthermore, the project identifies the likelihood of mainstreaming and scaling regenerative practices through knowledge sharing and workshops, innovation capacity, and strategic partnerships to ensure long-term sustainability. With a great mix of agroforestry, the 1-ha rented land works within the 600-hectare vital landscape of Herdade do Freio do Meios. Agroforestry and RA provide water supply, carbon storage, and soil erosion control.

Among the more than 80 strategic partners in reNature, I have identified five for this project: Farm21, Leopold Bachmann Foundation, Herdade do Freixo do Meio, GrowBack, and Baker Consultants. As well as several similarities, they have a common goal: enhancing soil biodiversity so that regenerative agriculture becomes more profitable and known. Documentation, intelligent sensors, and impact platforms are essential to strengthen business opportunities further.

Furthermore, a hybrid approach with innovative measurements, standards, regulations and reporting mechanisms works exceptionally by leveraging local knowledge for increased competitiveness for reNature on-site by utilising local knowledge. In addition, the global production networks (GPN) theory emphasises anchoring stakeholders and promoting transparency and clear communication within the agricultural value chain. Quinta das Abelhas' maturity and scaling possibilities will be discussed in reNatures' public timeline, along with market research, structure, and market opportunities.

Sammendrag

Klassisk jordbruk med dets store mengder kunstgjødsel antas å gi en uendelig tilførsel og skalering av matproduksjon, men det er uholdbart fordi det ødelegger matjorda. Det er først nå enkelte får øyene opp rundt dagens matsikkerhet. Ved å etterligne naturen og binde karbon samtidig, bygger regenerativt landbruk tilbake mer robust over tid, samtidig som det tåler langt bedre ekstreme værforhold. To feltturer ble gjennomført; på reNature hovedkontor i Amsterdam og på gården i Quinta das Abelhas.

Denne oppgaven undersøker Alentejo-regionen i Portugal gjennom en utforskende casestudie. Som en del av en systematisk studie undersøker jeg en agroøkologisk gård som ligger 1 1/2 time nordøst fra Lisboa for å identifisere barrierer og drivere for oppskalering av prosjektet, med ekstra oppmerksomhet rettet på det miljømessige og sosiale aspekteret. I tillegg er mange lokale, nasjonale og EU-interessenter involvert i denne saken mtp. en hybrid tilnærming fra topp-bunn og bunn-topp gjeldende utviklingen av regionen som et bærekraftig matfat. Videre identifiserer prosjektet sannsynligheten for mainstreaming og skalering av regenerativ praksis gjennom kunnskapsdeling og workshops, innovasjonskapasitet, pluss strategiske partnerskap for å sikre langsiktig bærekraft. Det er store forekomster av agroskogbruk og regenerativt jordbruk i det 600-hektar store landskapet i Herdade do Freio do Meios. Sammen arbeider interessentene med en flott blanding av regenerativt jordbruk for å bygge biologisk mangfold, kapre CO_2 og øke avlingene for bøndene. Økosystemtjenester levert av sistnevnte og agroskogbruk inkluderer vannforsyning, karbonlagring og jorderosjonskontroll.

Blant de mer enn 80 strategiske samarbeidspartnerne i reNature, har jeg identifisert fem for dette prosjektet: Farm21, Leopold Bachmann Foundation, Herdade do Freixo do Meio, GrowBack og Baker Consultants. Målet er å gjøre regenerativt landbruk mer lønnsomt og kjent gjennom innovasjon. Dokumentasjon, smarte sensorer og påvirkningsplattformer er avgjørende for å styrke forretningsmulighetene ytterligere.

Videre fungerer en hybrid tilnærming med målesystem, standarder, forskrifter og rapporteringsmekanismer ved å benytte lokal kunnskap for reNature’s økte konkurranseevne. Videre vil Quinta das Abelhas' modenhet og skaleringsmuligheter bli diskutert omkring sammen med dets markedsmuligheter, barrierer og drivkrefter med flere synergier.

Acknowledgement

I have been writing this thesis with a deep sense of mixed emotions, as acquiring so much knowledge about transitioning from monocultures to regenerative agriculture has been challenging. In regenerative agriculture, interest in sustainable development is mapped, monitored, and assessed.

My exposure to the industry has been greatly enhanced by reNature's strategic partners on-site in Portugal and the Netherlands. In addition, you have contributed significantly to my master's thesis by helping me visualise my academic journey using a project management tool called Monday. That includes all informants from the office level to local farmers on field trips with diverse knowledge. The overall process of completing the thesis has been challenging yet rewarding. It has given me a structure for my daily life during these unprecedented times.

Alexander S. Dodge was my supervisor and patient throughout the research and writing process. You have been inspiring and encouraging to me inspired and motivated throughout this process, provided insightful ideas, and provided supportive feedback. Thanks for all your help and support.

I am grateful for the unconditional support and love I have received from my family throughout this rich and meaningful journey. My life has been filled with love, laughter, and happiness due to their presence over the year and a half. I appreciate your constant support and being there for me.

Lastly, I thank my innovative circle of friends at Gløshaugen for their creativity, the entrepreneurial-oriented Spark* NTNU, and the cheerful and sporty NTNUI Athletic Games club. Thank you for connecting the pieces and making the most of my study time.

Best regards,
Fredrik Asche Kaada

Trondheim, 15.11.2022

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List of Abbreviations

AFS	Agroforestry System
AVC	Agricultural Value Chain
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CBO	Community-Based Organization
CDP	Carbon Disclosure Project
CER	Control of Erosion Rates
CFS	Committee on World Food Security
CIRAD	French Agricultural Research Centre for International Development
CMEF	Common Monitoring and Evaluation Framework
CO_2	Carbon dioxide
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
ECI	Economic Complexity Index
EEA	European Environment Agency
EFSI	European Fund for Strategic Investments
EIT Food	European Institute of Innovation and Technology
EQIP	Environmental Quality Incentives Program
EU	European Union
EU ETS	EU Emissions Trading System
FAO	Food and Agriculture Organization of the United Nations
FCT	Foundation for Science and Technology
FDI	Foreign Direct Investment
FFPI	FAO Food Price Index
FiBL	Research Institute of Organic Agriculture
FPI	Foreign Policy Instruments
FSN	Food security and nutrition
FTA	Free Trade Agreements
GFVC	Green Food Value Chains
GHG	Greenhouse Gas
GIS	Geographic Information System

GLTN	Global Land Tool Network
GMO	Genetic Modified Organisms
GPN	Global Production Networks
GRI	Global Reporting Initiative
GVC	Global Value Chain
HLPE	High-Level Panel of Experts on food and nutrition
HNVF	High-Nature Value farming
ICN	Institute for Nature Conservation
ICT	Information and Communications Technology
IEEP	Institute for European Environmental Policy
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
PTND	Participatory and Negotiated Territorial Development
IISD	International Institute for Sustainable Development
ILC	International Land Coalition
ILO	International Labor Organization
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IPS	Integrated Production Systems
ISO	International Organization for Standardization
ITC	International Trade Centre
IUCN	International Union for Conservation of Nature
LCA	Life-Cycle Assessment
NBS	Nature-Based Solutions
NDMI	Normalised Difference Moisture Index
NDVI	Normalised Difference Vegetation Index
NGOs	Non-Governmental Organizations
NOx	Nitrogen oxides
NSBNC	National Biodiversity and Nature Conservation Strategy
NVI	Nature value indicators
OECD	Organisation for Economic Co-operation and Development

PFA	Prioritised Action Frameworks
PPP	Public-Private-Partnerships
R&D	Research and Development
RA	Regenerative Agriculture
RAP	Rural Action Plan
RDP	Rural Development Program
RVC	Regional Value Chain
SAFA	Sustainability Assessment of Food and Agriculture systems
SARD	Sustainable Agriculture and Rural Development
SASB	Sustainability Accounting Standards Board
SCI	Sustainable Commodity Initiative
SDGs	UNs Sustainable Development Goals
SEPLs	Socio-Ecological Production Landscapes
SGF	The GEF Small Grants Programme
SMEs	Small and Medium-Sized Enterprises
SNA	Social Network Analysis
SVCM	Sustainable Value Chain Management
TEEB	The Economics of Ecosystems and Biodiversity
TEG	Technical Expert Group on Sustainable Finance
TR	Taxonomy Regulation
UN	United Nations
UNCCC	United Nations Climate Change Conference
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNFSS	United Nations Forum on Sustainability Standards
UNU-IAS	United Nations University Institute of Advanced Studies
VSS	Voluntary Sustainability Standards
WEF	World Economic Forum
WFP	World Food Program
WHO	World Health Organization
WMO	World Meteorological Organization
WTO	World Trade Organization

1 INTRODUCTION

An essential objective of this thesis is to provide a deep understanding of the mechanisms of regenerative practices in agriculture and agroforestry that are carried out under syntropic conditions in Portugal. As a result, the innovation lens is a natural choice for integrating incremental change patterns in agriculture with many stakeholders, from the soil to the fork. However, this is challenging as food sovereignty and security are at stake, placing control over territory and livestock in local food providers' hands.

Furthermore, it deliberately has its flaws, barriers, and drivers to be successful in boosting biodiversity, yields, and overall export value – from humid Quinta das Abelhas to, ultimately, the EU's certified food market. Besides absorbing policy frameworks and innovation capacity at regional, national, and global levels. However, while we have technology and data mapping at our fingertips, we need help to move about. Thus, let us move to the roots of the matter with conventional agriculture, where one of the multiple changes lies.

1.1 Introduction to the field

There is a race against climate change, and environmental developments as traditional agriculture contribute to increasing greenhouse gas (GHG). Following the same rhythms and doing business as usual has an anthropological meaning of normality (Connell et al., 2018, p. 70). According to the World Meteorological Organization (2021), the potent greenhouse gas methane gas represents a 16% total warming effect. Moreover, by 2016, 50 billion tons of carbon dioxide equivalent (CO2eq) had been released, with 73,2% coming from the energy sector and 18.4% from agriculture (Roser, 2022).

Portugal and the Netherlands are among the leading countries with strong farming conditions and traditions. The first mentioned has a richer diversity of plants and species but remains vulnerable if not properly managed. This is because, historically, the socio-economic picture shows more significant ties with the mainland along the shore. Therefore, considerable tensions and a gap may exist regarding protecting critical nature and biodiversity regards rural areas. The links were formed by prior socio-economic strengthening, not a timid EU cohesion policy of €25.8 billion and a Portugal contribution of €6.9 billion (European Parliament, 2021). Due to past years' stressful heat waves and dry seasons for monoculture and conventional farming, this is needed to build other critical natural capital (OECD, 2022).

Portugal's national and regional development structures must be examined more closely to identify its dry climate's barriers and enablers. Portugal has five administrative regions, 308 towns, 3092 parishes (freguesias), and municipalities on the mainland (CEMR, 2022). These authorities coordinate investment between municipalities, namely intermunicipal cooperation, meaning two or more municipalities agree to cooperate on any task assigned to them for mutual benefit (Council of Europe, 2022). These themes include environmental, drainage, sanitation, education, territorial planning, and consumer protection in Portugal. Alentejo and Centroto dominate these themes (European Parliament, 2021), plus by analysing success by region can demonstrate sustainability and regenerative investments by analysing success by region.

A close look at the central challenges to measuring performance in line with the 2030 Agenda (UNCTAD, 2018) is essential to improving performance. To emphasise this, from a top-down level UN has launched its Decade on Ecosystem Restoration (2021-2030) to address SDG15: life on land, forest degradation, desertification and biodiversity (Convention on Biological Diversity, 2022). Keeping nature and species diversity intact protects us against pandemics, which the grassroots level, represented by farmers and NGOs. As a stepping stone to the previously implemented UN Decade on Biodiversity 2011-2020 (UNCTAD, 2022). It demonstrates that action is being taken to capture significantly more carbon and build stronger nature resilience. However, change or improvement comes with friction and traction of monetary values compared to impact investing. That is one of the critical dimensions for gaining more traction in regenerative agriculture and agroforestry, hence needs improvement, e.g. with monitoring and evaluation.

1.2 Defining the research question

Through institutional innovation as a basis for social and ecological innovation, my work aims to develop a scientifically based, outcome-oriented approach to regenerative agriculture. To build resilient economies that mimic nature rather than destroy it, multilateralism and greater transparency are necessary to improve people's livelihoods. A structured outcome-based approach focused on double materiality based on impact versus financial metrics to identify gaps in previously studied outcomes.

It has four characteristics that legitimise institutional innovation, such as normative or value-laden innovation. Additionally, it is associated with logic that shapes practices, such as investments in entrepreneurship capacity and innovation, and progresses in bursts of change

over time (Raffaelli & Glynn, 2015). Due to its social construction and cultural embedding, it is a good match for a hybrid, systematic analysis of regenerative agriculture in Portugal.

Moreover, I am investigating the agricultural value chains in syntropic conditions to understand the complexity of global production networks (GPN), specifically agri-smart food production linked to prosperous and sustainable thinking. The research questions focus on a hybrid system approach that combines grassroots with smallholder farmers and top-down approaches with UN and EU agencies. Thus, we arrive at my current main contact business, reNature, in this exploratory case study of syntropic regenerative agriculture practice in Southern Portugal. Specifically, a one-and-a-half-hour drive from Lisbon to Quinta das Abelhas. A part of reNature's extensive partner network on-site, Herdade do Freixo do Meio, owns this land. Furthermore, field trips to reNature's headquarters and on-site in Portugal are needed for allowance to build a solid relationship in these unprecedented times. Shortly, this angle is formed with this problem statement:

In Portugal's Alentejo region, how can a hybrid approach and innovation lens be applied to achieve a systemic transition from monoculture to regenerative agriculture?

Due to the broader timeline of this thesis, I have developed two subquestions addressing the nuances of my research question:

- R2: *What are the key barriers, enablers and drivers to scaling up regenerative agriculture in syntropic conditions in the Alentejo region of Portugal?*
- R3: *How can agricultural value chains successfully assess and utilise carbon and biodiversity initiatives across local to EU levels?*

Agroforestry and regenerative agriculture provide excellent examples of nature-based solutions (NBS) in Portugal. These practices safeguard biodiversity and people by harnessing the power of healthy ecosystems and nature (IUCN, 2022c). Innovation can contribute to impactful results, such as food sovereignty, by being managed well through layers of management. Then by doing so, increase the likelihood of reaping long-term benefits for multiple stakeholders. Further, short- and long-term documentation and funding are required to operate to achieve impactful results. In addition to increasing productivity, reNature practices also enhance biodiversity. For businesses like reNature to continue operating efficiently, a transparent global value chain (GVC) must be created and implemented.

FAO and FiBL suggest with the Knowledge Exchanges Field that a particular greening of food value chains (GFVC) is a rapidly evolving (FiBL, 2014). Vertical integration requires control and liability when managing exports and operating a business. To achieve food security and livelihood, solutions must be integrated considering each area's context (Sroufe, 2018). Reliable navigation of top-down and national and regional policies and regulations is necessary to reach the grassroots and gain their trust in the political will and action (Auvinen et al., 2015). Thus, management of these processes goes beyond the classic return on investment (ROI), hinting to impact investing, considering the biodiversity of multiple species and the knowledge and technology needed to maintain them for a long time.

1.2.1 Previous research

First, the umbrella term global production networks (GPN) stretches from Neil M. Coe and Henderson et al. (2002) early on to Henry Young (2008) and Dicken (2014) as lead authors. Combined with the socio-economic understanding developed by Coe et al., the last mentioned discusses territorial embeddedness, the nodes of change, and context to a place, with visually precise figures.

In addition to food security and sustainable transitions, many articles have been written about GPN and sustainability. Due to its nature-positive centre of prosperous soil for food production, multilateral issues require a regenerative approach. The Wageningen University, a world-class research institute, examines agriculture, biodiversity, climate change, water, health, and humans concerning biodiversity in our food supply. Modern agriculture and food systems are at the core of the university's function, which continues to foster leading knowledge in these areas. Furthermore, Dicken (2014), Coe (2008), and Yeung (2009) have particularly specialised and contributed in, respectively, GPN and strategic coupling, analysing potential lagging regions and stating the role of facilitation of critical development.

In contrast to many businesses, reNature and its partners go beyond making it net zero. By advocating a regenerative business set-up, they tend to regenerate—to regrow or be renewed or restore gains for balances that matter in most of them. As a result of a lack of knowledge, expertise and political legislation, businesses tend to think in silos, ignoring the nuances and urgency of sustainability surrounding them, resulting in increased short-term costs.

On the topic of agroforestry and regenerative agriculture, there is a continuous flow of new articles, but not directly connected to the buzzword of ESG, environmental, social and governance (Bradley, 2021). Then there is a vital need to decouple ESG from sustainability regarding materiality, impact, and finance based on an existing gap to cover among researchers. On the other hand, Dagar et al. (2020) has gained a strong presence in the agroforestry literature with two books within a four-year spawn. Especially on the management set-up, in combination and regulating and provision of services, sketches out the agroforestry system as a historic, well-oiled system throughout human evolution.

Running a global value chain and managing multiple stakeholders across the GVC requires key management to build business cases to maximise value in the long run. As a result, Robert Sroufe (2018) discusses integrated management, incorporating value measures, impact management, and accounting drivers of genuine business opportunities. Additionally, Pike et al. (2017) demonstrate a firm anchorage for innovation and regional development based on inter-actor interactions. As I integrate sustainable development practices and interrelationships between stakeholders into my thesis, I intend to strengthen the case for regenerative agriculture, especially concerning policy framework and the coverage of sustainable development practices.

A robust, sustainable transition to regenerative agriculture through multilateralism is specified in this thesis by referring to the literature above. Not to mention identifying the drivers and barriers to regenerative agriculture in humid conditions by going in-depth on previous research perspectives. In this way, this thesis fills a gap in the literature. It contributes to grasping resilient climate techniques for communities in Portugal and further usability worldwide by using an innovation lens and a well-laid-out agricultural value chain with its fragmented networks.

1.3 Justification and signification of the study

There has been extensive strategic planning on agriculture and degraded land by several UN organs and the EU over the past four decades. As consumers become increasingly aware of sustainability, this term often falls between two chairs or is misunderstood as an indirect barrier to improving the environment.

As our society undergoes several ongoing and significant transitions, the agriculture sector is no different. It is known for its monoculture traditions, high fertiliser use, and degraded land. Governments and EU funds subsidise it heavily, but slow-moving processes due to complex regulations, long lifecycles, and small profit margins do not make it easier and romanticising it is not an option. As firms tend to stick to their core technologies, such factors stabilise existing socio-technical systems and prevent change (Markard et al., 2012). Over the past decade, extreme weather events have increased due to climate change, affecting livelihoods and the environment. As a result, substantive change is essential, involving many technical, institutional, political, and sociocultural aspects.

Regenerative agroforestry and agriculture practices are, in fact, a much-needed solution for the common good. For a significant scale-up to happen, it is vital to master the awareness and information flows across multiple stakeholders. Throughout this thesis, I will revisit this area, guiding you through the complexity of its strategic links.

1.4 Thesis outline

A science-based methodology allows for nature-based solutions (NBS) to be implemented, such as regenerative agriculture with intelligent sensors and knowledge sharing. The thesis is divided into seven parts, with chapter two presenting the historical development and the benefits and practices of regenerative agriculture and agroforestry. As discussed in chapter three, a multilateral partnership with territorial embedding at several levels is essential for social and ecological innovation as part of overreaching institutional innovation. The fourth chapter provides a clear description of the chosen methodology, methodological crossroads, and the quality of the research design. In contrast, the fifth chapter explores the hybrid bottom-up/top-bottom model in more depth, along with ESG and policy framework, to sustain a viable case of food sovereignty based on onsite operations. Various visuals illustrate the incremental improvement in regenerative agriculture across the agricultural value chain through monitoring and evaluations of precision farming coupled with technical expertise and precision farming.

My assessment includes on-site experiences, drivers, barriers, and enablers linked to upgrading and making the regenerative business case transferable and scalable. The sixth chapter discusses critical findings and patterns that can be identified, including fiscal policy and multistakeholder approaches. This is complemented by understanding the implications of

the United Nations Sustainable Development Goals and responsible governance. Then the final chapter brings together the main takeaways, bringing the analysis to an end.

1.5 Personal motivation

In my life, I have always had an exploratory mindset and always strived to achieve higher peaks in the great outdoors. However, this thesis focuses on bare land with minimal elevation, reflecting my passion for natural resources and people. My project management, innovation lectures, and part-time jobs have allowed me to gain a wealth of knowledge by taking a systemic approach with a problem-solving attitude. Additionally, I worked on UNCTAD's sustainable development goals (SDGs) between the autumn of 2018 and 2021 on a hands-on basis. In preparation for my master's thesis, I understood how complex regulations could be handled top-down, leaving me curious about bottom-up integration. Shortly, agroforestry and regenerative agriculture are approaches I am interested in learning about to develop sustainable agricultural development at scale.

2 Regenerative agriculture

At first glance, agricultural practices removing carbon from the atmosphere and replanting it in the soil are contributing to curbing climate change. Documenting the process through technical work and utilising drones and digital tools is a neat way to optimise operations and production overall.

A geographic information system (GIS) is used to sketch and monitor the area to build ecological resilience and other natural selection and map the terrain. Data from farms in Portugal and Spain, for example, will be captured, checked, and displayed in the system based on positions on Earth's surface (National Geographic, 2022b). This is of particular interest given the smallholder regenerative and agroforestry farmers on the delivery of ecosystem services such as soil fertility, shade and nutritional value (Dagar & Tewari, 2018, pp. 604-605). Keeping agrobiodiversity contained throughout a smaller area is possible with a high density of species across a small space, such as 3-5 ha. The site is optimised with a natural blend of crops and agroforestry to combat pests and increase soil organisms and pollinators.

2.1 Industry background

Agriculture diversification is achieved through agroforestry systems (AFS) designed to grow trees intentionally in conjunction with regenerative agriculture. An age-old land system

where agricultural land is defined as agroforestry with more than 10% tree cover. In light of this, trees play an integral role in improving soil fertility, pollination, and nutrient cycling (Dagar et al., 2020, p. 35). Several upsides are represented, meaning its methodological approach can reduce climate change while improving food security and the local economy. It gives shade and acts as a crucial nutrient supporting crop and plant growth and enhancing carbon sequestration in soil and plant biomass (Kim & Isaac, 2022). Further, a continuation of change and environmental upgrading on-site is also part of the evolutionary approach to local and regional development (Pike et al., 2016, pp. 105-107). As a result of the many vertical and horizontal connections, increasing regional adaptive capacity is essential for building long-term resilience.

The AFS cropping system incorporates trees and shrubs into the cropping system, capturing more carbon into the soil and vegetation than monocultures. The systematic viewpoint has gained extra momentum since World Agroforestry Centre, previously ICRAF in the 1970s, built upon the routine handling of AF. The nodes' five elements include provisioning, supporting, habitat, regulating and cultural services – from degraded to rehabilitated and restored land fields (Dagar et al., 2020, pp. 33-35). This aims to repair ecosystem services overall.

The carbon stock can provide ecosystem services of environmental, social, and economic benefits by increasing the carbon market. A win in several areas, where the crops can thrive and minimise the pollution of traditional methods. AFS can also function as a carbon sink, allowing, e.g., poor smallholders to benefit from carbon schemes and reduce their emission-reduction costs. In addition to facilitating sustainable agricultural practices, carbon revenue could boost soil productivity, restore degraded drylands, and combat climate change. This is great information to absorb to optimise Portugal's central and southern parts of arable land, grasping the problem of desertification. A short comparison to its neighbour in south Spain, it measured climate change could amplify the effects of, e.g. excessive use of water for agricultural irrigation (National Geographic, 2022a). It is challenging to grow food, collect water, or change habitat when the land becomes incredibly dry or desert. Human health problems can result from this, such as malnutrition, respiratory disease caused by dust and other diseases caused by a lack of clean water - highlighting the critical functions of AFS.

Agroforestry and regeneration agriculture are also highly adaptable and sequester more carbon. AFSs sequester carbon based on climate conditions, site characteristics, plant species, stand age, and cultivation methods (Nair et al., 2009). estimates of carbon sequestration potential vary widely. In AFS, carbon sequestration ranges from 0.29 to 15.21 mg per hectare, while below-ground carbon sequestration ranges between 30 and 300 mg per hectare to a depth of one meter (EEX Group, 2022). Based on the carbon accumulation rate and operating margins, the price fluctuated between $30 and $1 per tCO2e.

2.1.1 The regulatory framework of regenerative agriculture

To reduce greenhouse gas emissions cost-effectively, the EU has adopted the Emission Trading System (ETS), a cornerstone of its climate change policy. In phase 4, a net 55% reduction in greenhouse gases will be achieved through a mix of interlinked measures to achieve this target from 2021 through 2030 (European Commission, 2022d). Several economic, technological, and political factors affect the amount of carbon sequestered annually.

Climate change caused irreversible damage to terrestrial ecosystems and intense wildfires and heatwaves on land, according to the IPCC's Sixth Assessment Report (Ar6) summary for policymakers (2022). Portuguese farmers faced three heatwaves during the summer of 2022, demonstrating the importance of climate change resilience. Given its severe development, this threatens their livelihoods and socioeconomic standing. Farmers are already in increasing demand for deliverables, but many are outside of organised circles, so they are restricted from accessing profitable export markets. Strategies, services and standards represent the formal conditions throughout the process and required soft skills like knowledge upgrading for the workforce.

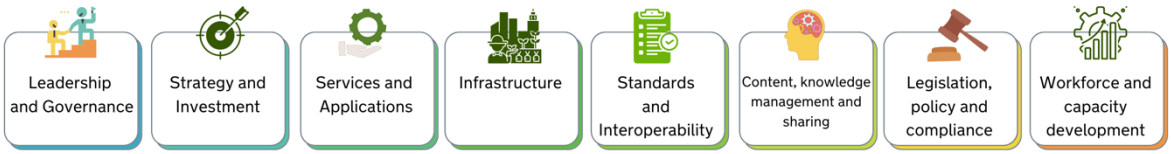

Fig. 1 – *Relevant system factors to tackle scaling up regenerative agroforestry and RA.*

The landscape of policy change and improvement in practice (*fig. 1*) must be navigated to achieve nature-positive solutions that are outcome-based. FAO and UNEP are among the international regulatory mechanisms that use a top-down approach to increasing yields and climate resilience, along with EU Taxonomy, IUCN, and the EU Biodiversity Strategy 2030.

To increase the likelihood of a nature-positive state of living (2022b). The latest IUCN Leaders Forum (2022a) further highlighted the mission. Lastly, the UN's 17 sustainable development goals (SDGs) guide best sustainable practices through trackable targets and parameters with their 169 targets and 231 unique parameters (United Nations, 2022b). They are interlinked so that several SDGs can be part of one concept, e.g. quality education and skillset on regenerative agriculture. As illustrated (fig. 2 and appendix E), life on land (SDG 15), clean water (SDG 6) and climate change (SDG 13) are elementary, given their essential biosphere as a base for our lives and socioeconomic developments.

Fig. 2 — *UN's Sustainable Development Goals*

2.2 Essence of soil and land management in regenerative practices

Regenerative agriculture and AFS offer a natural way of cutting out fertilisers, reducing tilling and improving soil and water health. Keeping this in mind fosters a healthier life on land and lowers the barrier without the commonly high startup costs of monoculture, e.g. fertilisers, part of the toxic chemicals mix. Additionally, it lacks severe crop diversity (Nink, 2015). Moreover, a chemical and energy-intensive sector could benefit from cover corps to deal with draught by utilising natural water conservation fields (European Commission, 2022e). This is particularly given the intensive heat waves across Southern Europe, where Portugal is no exception. Not to mention the constant threat of potential risk and pest outbreaks as consequences of the varying nitrogen levels in the soil focused on a small portion of seeds and plants.

By maintaining a high level of biodiversity, the Montado system has created a buffer zone against global desertification. This term builds upon the degradation process by which a fertile land changes into a desert by losing its flora and fauna. Causal reasoning links drought, deforestation, climate change, and human activities. Two of reNature's strategic partners, Herdade do Freio do Meio and Leopold Backman, also rely on this system, which covers over 1 million hectares of (reNature, 2022a). The water content in Montado agroforestry systems is 13% higher than in conventional monoculture systems. Regenerative agroforestry, especially of type multi-strata agroforestry, has higher organic matter contents than monoculture as a land-use practice (Dagar & Tewari, 2018, p. 599). Due to nitrogen fixture and regenerative agriculture, farmers can produce milk, fruit, vegetables, etc., despite humid and syntropic climates.

"*The integration of technologies in the scalability of regenerative systems will allow bringing more economically viable cases will motivate farmers to transition to a resilient system that adapts to the impacts of climate change."*
- Felipe Villela, CCO and co-founder of reNature

The critical characteristics of regenerative agriculture must be understood before much technology can be applied. The spatial planning of the landscape, the maintenance of a constant level of vegetation cover, the reduction of soil disturbances, and the stabilisation of soil mineral complexes are necessary to achieve a high degree of interactive effects (Sroufe, 2018, p. 119). By increasing organic material, increasing plant nutrient and water use efficiency, and restoring microbial life, the area is also strengthened against climate change. Doing all this with proper measurements would be a good use, leading us to improvements in technology and innovation for regenerative agriculture.

2.3 New technological developments

Agroforestry and regenerative agriculture demonstrate their significant value through incremental innovations like intelligent sensors, drones, and GIS connected to data platforms. The further point is that incremental learning is shaped over time, as is the commitment to experimental learning education linked to resource commitments (Mitra, 2020, p. 292). Technology is constantly evolving and is quickly adopted by small and medium-sized enterprises (SMEs) of all sizes. Mitra (2020) and Cavsugil (1980) argue that this knowledge is a crucial component of farm system technical and managerial expertise, allowing it to grow exponentially.

As global value chains (GVCs) become increasingly interconnected, a source-based approach makes sense because data becomes increasingly important. (Dicken, 2014). Production nodes are established at grassroots levels in this network to take a product or service from conception to market with geographical and organisational control (Dicken, 2014, pp. 70-71). This is important, as it underlines the thesis' aim of contributing to a vital upgrade for current food security and sovereignty practices amid extreme conditions.

2.4 A hybrid approach to scaling up regenerative agriculture

By promoting and implementing regenerative agroforestry, reNature ensures farmers' financial resilience while restoring landscapes (2022c). Its vast network and global impact are

a foundation for the company's core mission. By approaching the issue from this perspective, the company is building upon the social and ecological innovation concept - a field I will explore later. To lay the groundwork for ongoing analysis, let us sketch out the essential elements of policy regulations and impact assessments.

Fig. 3 – *Stakeholders that set the basis for an outcome-based approach to scaling up RA.*

At the bottom are two layers - a grassroots level with farmers, followed by organised circles of interest such as non-governmental organisations (NGOs) and civil society organisations (CSOs). UNDP 2022 defines NGOs and CSOs as non-profit, voluntary organisations independent of the government and market (UNGP, 2022). Transparency and dialogue are crucial soft skills for ensuring a greener economic recovery and generating social and environmental benefits due to the complexity of stakeholder engagement. Agricultural ecology stresses the importance of social movements and institutionality. In the next chapter, I will further stimulate discussion on boosting regenerative agriculture and agroforestry practices by introducing an informative agricultural value chain. Last but not least, custom figures *1* and *3* illustrate early nodes of agricultural value chains (GPN theory) in the hybrid approach to RA analysis.

3 Theoretical framework

In the next chapter, I will outline the theoretical framework for this thesis. To achieve this, it is necessary to understand interactions between stakeholders. Regional and local connectivity is derived from tacit knowledge and innovation. Land management and policy implications influence the likelihood of scaling up regenerative systems in syntropic conditions.

With the integration of social and ecological innovation, chapter five will present a comprehensive empirical review of sustainable finance, environmental, social, and governance domains. Additionally, I intend to identify strategic options for scaling up hybrid

agriculture based on regenerative agriculture. The ability of firms to incorporate nature-based solutions such as regenerative agriculture (RA) and agroforestry systems (AFS) and their implications for the attached stakeholders can be improved. In response to society's environmental pressures, global production networks (GPNs) will integrate today's economy as vital nodes to capture export value.

Additionally, I will review the literature on hybrid modelling and systematic approaches, including smallholder farmers and EU policies and regulations. The agricultural value chain (AVC) is a system of interconnected layers and central mechanisms. It incorporates accounting drivers, enablers, barriers, performance evaluators, and the firm's capabilities and capacities. These elements will be discussed in light of nature-positive systems, popularly synonymous with nature-based solutions (NBS). Natural resource-based economies promote economic, environmental, and social well-being through a wide range of activities and practices enhancing biodiversity, natural capital, ecosystem services, and quality of life for people and other species (Dagar & Tewari, 2018, p. 376).

3.1 Integrated management

Managing uncertainties in the market require strong ownership of a firm's resources. As a result, integrated management creates a context of integrated future value and return on integration, for example, sustainability (Sroufe, 2018, p. 20). Agriculture is subject to the notion of competitiveness driving changes within industries. A resource-based view of strengthening the system from local to national to international deliverables (Mitra, 2020, pp. 292-293) was maintained by Penrose et al. (1980). This is a win-win situation for effective adaptation mechanisms to deal with market volatility when firms share knowledge and labels with consumers.

The network-centric approach (NCA) advocates social movements as socio-ecological movements. Through an external perspective focusing on innovation, Nambisan and Sawhney (2008) aim to improve the quality and speed of the organisation's products and services by connecting with external networks, partners, and communities. Today, as service-based businesses grow globally, a participation architecture aimed at sketching out mechanisms and facilitating value creation is imperative (Mitra, 2020, p. 315). In addition to an enabling environment, external auditors should be invited for sustainability data to be verified regards reliability and legitimacy (Schmidt et al., 2019, pp. 231-232). To maintain

the health and quality of the natural systems we rely on, we need to know how human activity impacts the environment. It is possible to verify this type of data from a social and economic perspective through value creation levers and new market entry strategies accompanied by calculated risks. By doing so, we are linking margin improvements with shareholder value and market share with a mix of, for example, a stronger brand and market access.

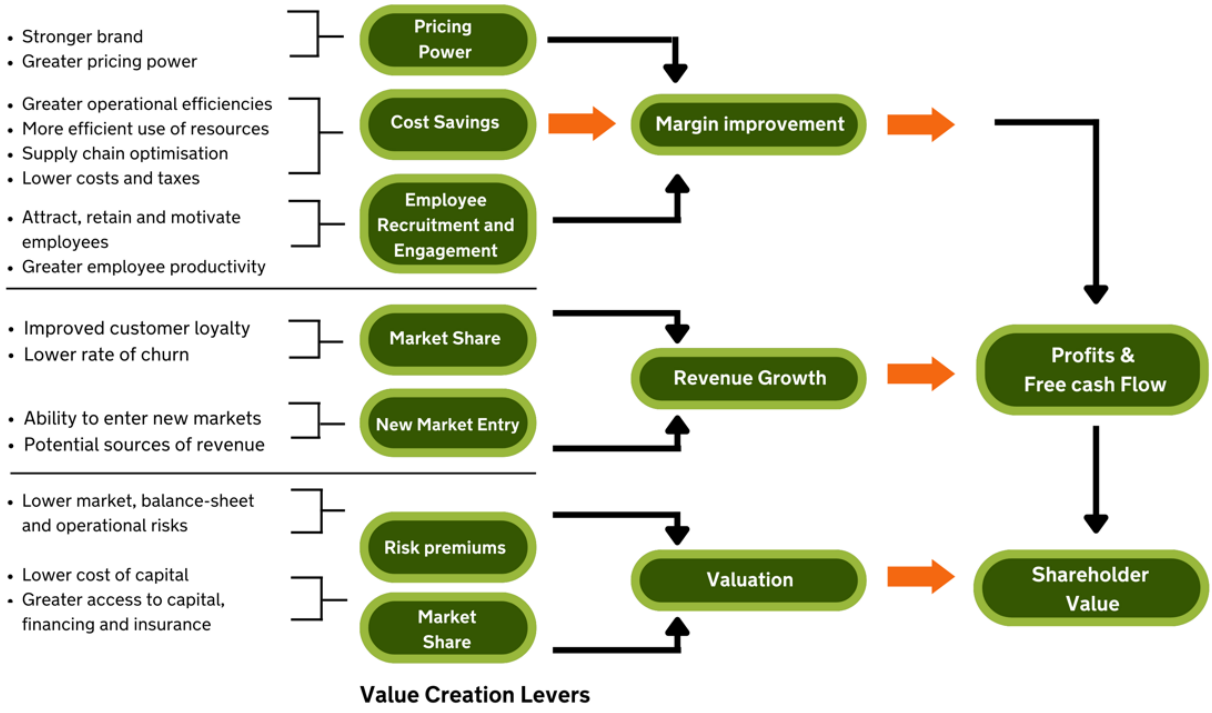

Fig. 4 – *Value realisation. An illustration of S.Roufes's value creation levers (2018, p. 141).*

Interestingly, Robert Sroufe shares the importance of measuring impact with an aligned drive to operate (2018, p. 141). A key aspect of integrated management is identifying material issues and elements to grasp internally and what needs to be communicated externally. As part of this analysis, the author highlights one of the most crucial intelligence bases and organisations supporting sustainable cooperation, the World Economic Forum (WEF). The international-based organ states an upwards curve for businesses incorporating the sustainability (WEF, 2022). Since we are on the track of sustainability development, Gro H. Brundtland's definition of the term is a *development that meets the needs of the present without compromising the ability of future generations to complete their requirements* (United Nations, 2022c). A long-term focus on the past, present, and future of syntropic farming practice sets a course for incremental improvements. In this thesis, I will evaluate the

scalability of RA by evaluating positive circles of influence created by calculated risks, measurements, and strategy implementation.

Improved anchoring in the supply chain, geared toward long-term customer loyalty, can be used for calculating operating margins, new market entries, and potential revenue growth (Sroufe, 2018, pp. 139-141). As illustrated in *fig. 3* was part of his early inclusion of interactive components that considered critical customers, capabilities, and value propositions. In this context, a value proposition means a short statement communicating why buyers should choose RA over traditionally produced food. Further, happy and productive employees advocate for building a stronger brand, thus improving overall margins and profits. At the same time, there may be an urgent need to perform risk assessments to be prepared to tackle potential hindrances along the road.

3.1.1 Removing barriers to integration for sustainable investments

The upgrading of a firm's sustainability trajectory is not a guarantee of success, as markets are often volatile and unpredictable. The World Resources Institute (WRI) noted that firms that fail to see the business opportunity holistically in less than 18 months are less likely to see long-term benefits and stability (2022). The value proposition and customer demand, e.g. organic labelled products, shapes the business model to stay up to date (Sroufe, 2018, p. 43). The labelling is a shortened way for consumers to buy alternatives (*fig. 1).* At the same time, using fertiliser ensures an evergrowing food production in which most sellable crops are carefully handpicked to standards. However, it raises an environmental concern for long-term production and soil quality.

As a result, Sroufe stresses the need for a clear strategy and roadmap to reach the goal through objectives, goals, strategies and measures, with the acronym OGSM (2018, pp. 34-35). Spelt out as objectives, goals, strategies and actions, in context with short-term gains versus long-term implementation whereby organic reasoning is built into the calculation. This includes precise measurements, tackling the complete picture with transparent capital allocation, reputation and value-added approach. A business model that ensures profitability and provides value to society is sustainable. Roufe (2018) sketches that systems thinking synthesises a problem with causal relations and critical patterns to leverage the value chain and its functions; hence risk assessments are needed. This is especially useful for operations investing in sustainability projects, with value creation and innovation as part of an integrated

problem-solving approach (Sroufe, 2018, pp. 37-39). Here, materiality is beneficial to navigate to uncover leverage points within the applied integration in project management.

3.1.2 Value capture and growth trajectories

First of all, the essential piece for a business is the customer. This means connecting the nodes of the firm to capture valuable feedback and serve existing and new customers (Sroufe, 2018, p. 120). A solid value proposition's trait outlines a rich feature set available with attractive benefits while satisfying the financial and strategic objectives of its internal key performance indicators (KPIs).

The essential piece for any business is the customer. A crucial part of defining a firm's dynamic capabilities is its operational capabilities from management and skillset. Roufe (2018) demonstrates that KPIs can help drive effective and well-planned operations, as illustrated in use cases for business management and environmental performance (2018, pp. 46-47). The company offers its customer base value-added services in terms of environmentalism, e.g. through carbon offsetting as travel and aeroplane companies do. On this matter, it provides customers with value-added services externally and builds relevance to a changing enterprise climate.

An essential part of a firm's dynamic capabilities is its operational abilities from management and skillset. Now, *dynamic capabilities* refer to shaping competitive advantages, evaluating strengths, weaknesses, and insider knowledge (Tidd & Bessant, 2018, pp. 150-151). For this to happen, collaborative actions where workers and participants contribute across disciplines are vital to adding value as regards problem resolution (Sroufe, 2018, p. 62). This site aligns with Taylor's view on standards and coordination of strategic interactions, including for new technology to flourish (Taylor, 2016, p. 173). Standards are essential in capturing values and building prosperous economies in this continuum. Private actors should ensure that their business methodology and operations are secure. Not to mention network effects when producers and consumers adopt, e.g. food safety and environmental standards.

Operating margin

Given a firm’s business and technology strategy, one must know its margins and operations zones to make clever decisions (Connell et al., 2018, p. 148). According to Sroufe, *operations* refer to managing business practices to create the best efficiency possible

within an organisation. Besides procurement and supply chain management, this also includes relevant services, performance measurement and a clear, integrated value maximisation, e.g. in the organic farming (Sroufe, 2018, p. 49). Moreover, regards economic metrics, dividing net income by the total operating expenses yields the active margin (Sroufe, 2018, p. 129). When building on sustainability trends and standards, one must own a brand to answer any critical business complementarities.

Additionally, operating expenses include interest expenses on long-term debt, which are not included in capital expenditures. It boils down to demand and supply management, where the firm's core competitiveness, a mix of expertise in technology and the flexibility to allocate resources smartly is a good move (Connell et al., 2018, pp. 149-150). This approach allows one to track and evaluate traceability, visibility, and external drivers linked to materiality accounting. This is practical for documenting and scalability reasoning, leaning into growing a more extensive customer base and increasing retainers of a monthly customer base.

In the sustainability space of land management, potential fertilisers, GHG emissions and water management need to be accounted for (Sroufe, 2018, p. 127). These calculations can be a good case with innovative land management services, e.g. alley cropping or agroforestry, for a better and more resilient field as a service for increased yields and biodiversity (Dagar et al., 2020, p. 119). Since the trees are naturally grown and managed, especially by traditional means, the costs are pretty low for the farmers to thrive as the system is helpful for farmers' livelihood (Dagar & Tewari, 2018, p. 825).

3.1.3 Social and ecological innovation – A hybrid set-up

Policy responses are analysed from a top-down perspective, from the state to the national, regional, and supranational levels, as is the case with the EU and the UN. The bottom-up approach is used by smallholder farmers at the grassroots level – organised or not. Combined with this illustration, it fits perfectly with the case of regenerative matters in contemporary, multifunctional landscapes.

The need for an integrated approach to landscape management is clear, as it can provide the basis for achieving multiple goals such as biodiversity conservation, the protection of water resources, climate change mitigation, and food security (Dagar et al., 2020, p. 145). In

addition, it has been shown that a well-managed landscape is also attractive, regards improving livelihoods, health and income generation.

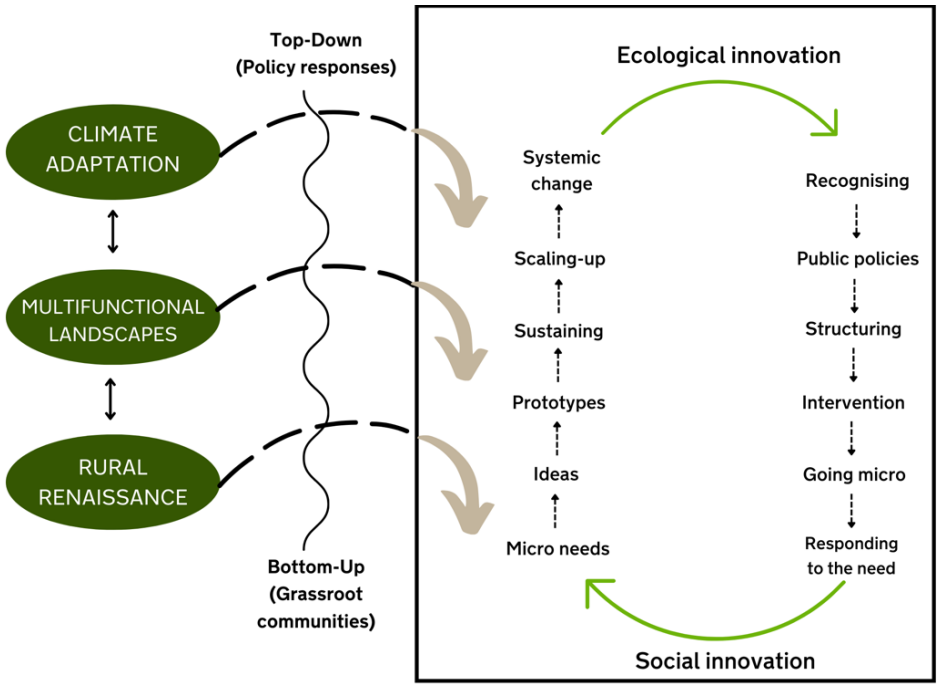

Fig. 5 – *A hybrid approach: Top-down vs bottom-up with integrating social and ecological innovation (Vizinho et al., 2021, p. 16).*

As illustrated in *fig. 5*, efficient, systematic thinking can guide ecological and social innovation. Also, participating in outreach and marking a social need to meet social needs, for example, better living standards and yields, sustaining the smallholder farmers for an increased success rate.

Based on a market-seeking theory from the umbrella global production networks (GPN) theory, their size, structure and accessibility are marked as vital fields(Dicken, 2014, p. 119). The need and ideas for a better food system occur, and prototypes are set up and sustained. From there, horizontal or vertical expansion factors regard national structure, and its boundaries within specific regulations set the ground for further expansion. Fig. *5* is one of two prominent figures utilised to anchor theory and practice, where an agricultural value chain (AVC) marks the second, spun out from a GVC.

Solid anchoring to the roots of regenerative functions within the AVC is of interest due to the integrated core functions and technology development. Specifically, ecological innovation, in

this case, includes new and more appropriate tools, techniques and methods available for a given situation. To achieve the highest level of environmental innovation, we should consider developing an understanding of the specific environment and its particular characteristics of the place (Dicken, 2014, pp. 119-120). Second, creating a system-level view of the different processes in the soil and the ecosystem. Third, consider all relevant factors, including human interactions, social context, and environmental conditions. Lastly, improving the methodology used for data collection and analysis.

In the innovation Field's social transition and upgrade phase (Rotmans & Loorbach, 2009), many actors, institutional changes, values, and technologies are involved. As part of this thesis, industry, technology, markets, policy, and farmers' society are discussed concerning society transitions in the context of a continuous effort on regenerative agriculture, which is complex and requires systematic policies (Grin et al., 2010). Societal transition studies have two primary objectives: scientific progress to better understand structural changes in large social systems. A vital component of the overall impact is facilitating specific transitions and steering development towards sustainability.

Ecological innovation aims to solve environmental problems instead of social problems. Often referred to as eco-innovations, eco-innovations involve reducing greenhouse gas emissions (GHGs) and waste and protecting ecosystems by utilising natural resources more responsibly to attract foreign direct investment (FDI) and unlock feasible growth potential. One should not ignore accessibility to *knowledge* and *labour* and evident leadership in shaping the breadth and depth of education for the given geographical place (Dicken, 2014, pp. 119-121). These are several traits that play a role in understanding the base layer for grassroots communities of farming.

Innovation involves changing how goods and services are produced and marketed for the first difference between innovation and research. Agriculture research and innovation are beginning to reveal their limitations as an understanding of innovation processes has improved. As a result, stakeholders began expecting it to resolve more complex issues, such as rural poverty, food insecurity, nutrition, and resource management. Since the 1970s, agricultural research institutes have been replaced by enhancing research systems, facilitating technology transfer, connecting researchers with farmers, and strengthening agricultural innovation systems.

3.2 Global value chains

Many countries depend heavily on global value chains (GVCs) for their development and are an essential part of the worldwide economy. Due to this, scholarly research in this area is becoming increasingly popular. Some scholars, such as Dicken, have examined how global value chains affect economic growth and development internationally to regulate and stimulate an economy through trade policies and access to (new) markets (Dicken, 2014, pp. 188-189). In a GVC, a single input is taken, transformed into a service or product, and distributed across multiple markets to consumers.

Embedding GPN operations in the local economy

Essentially, GPNs are the costs and effects associated with globalisation, including intensified trade. It also deals with social and political characteristics across stakeholders to build a compelling argument for the unique landscape. The success of projects and SMEs depends on their ability to adapt to the environment, capital raised locally, and export/import capabilities.

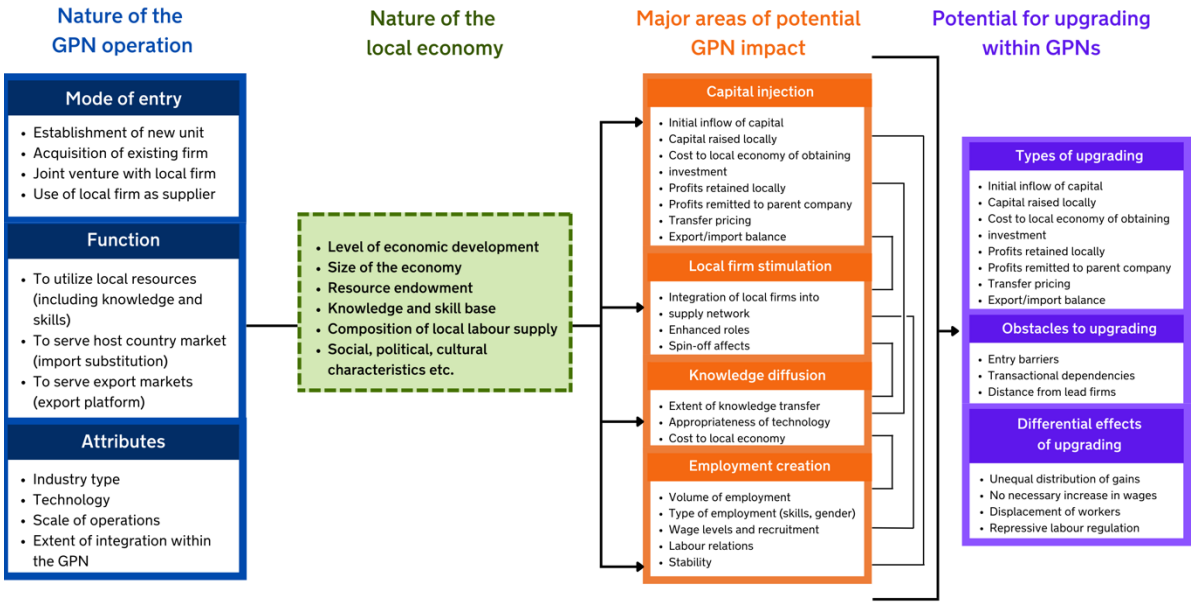

Fig. 6 – *Nature of the GPN framework vs the local economy and its impact (Dicken, 2014, p. 256).*

This notion of GPN focuses on the effects and costs of globalisation, such as increased trade and dynamics. Furthermore, it is utilising knowledge and skills to build a suitable case for the unique landscape at a local level, taking into account social and political factors. A project or small and medium-sized business's success depends on its adaptability to its environment, its

ability to raise local capital, and the puzzle of export and import (Dicken, 2014, pp. 188-189). GPN can have significant impacts economically, and at the same time, the socio-economic conditions, referring to labour relations and the extent of knowledge transfer (*fig.6*)., can either boost or put the operation on hold. A top firm can reinvest in new areas and emerging economies. However, if the business strategy, local firm, and process are stimulated, it can result in heavy entry barriers (Dicken, 2014, pp. 258-259).

The critical issue is that when the degree of environmental upgrading and downgrading in GVCs increases, the likelihood of their success will increase, and vice versa. As the name suggests, GVC is the cross-border network that takes a product or service from conception to market with its stakeholders. Furthermore, it is crucial to understand that international supply chains encompass everything from manufacturing to delivering goods and services across national boundaries. Embeddedness and contextual understanding of local actors, their dependencies, and business associations play a prominent role in potential GPN relationships (Dicken, 2014). According to Dicken (2014), social upgrading refers to improving proper entitlements and work agreements(Dicken, 2014, p. 272). By establishing a fair and ethical contract, the producers onsite can use their specialised knowledge in the company's best interest.

Mainstream vs community economies

As firms have grown in size and complexity, they have undergone environmental upgrades and downgrades. As a result, a successful project generates profits. In contrast, an unsuccessful project causes losses, where the economic impact is either positive or negative and is determined by the competitive nature of the industry, the degree of structure, fragmentation or wholeness of the economy, and the degree to which it is locally self-sufficient (Gibson Graham, 2006; Dicken, 382). In addition, a successful project benefits all parties - consumers, producers, and investors - since monetary values are just one central factor in societal and impactful value. A successful product, for instance, may lead to a positive economic impact on consumers. Successful investments may positively impact an investor, while successful acquisitions may increase a company's profits.

3.2.1 Sustainable global value chains

Businesses and politics use sustainable global value chains (SGVCs) to describe economic models that minimise the negative impacts of products and services produced in a country

(Schmidt et al., 2019). It has been criticised for needing concrete results and focusing on economic problems rather than broader social issues such as labour conditions and human rights. Further, the core basis of a business and its adaptiveness to a changing landscape could make or break the company long-term. By having control of its operations, production efficiency and adherence to the *code of conduct*, company ABC can attract a better and more skilled team (D'Heur, 2016, p. 100). A firm's code of conduct represents the standard policy of practising ethics and improving business. Lastly, these elements are part of the business DNA and core system. In contrast, a value chain is considered sustainable if each stakeholder can carry out their activities in a financially viable manner, for example, by building profitable and healthy ecosystems at the same time. It means mixing an outcome greater than simple profit for the involved.

Triple bottom line

A triple bottom line (TBL) is a concept used in accounting, business, and management that considers the effects of the organisation's actions on people, the environment, and the bottom line. In the context of Dickens' view on local ownership to the process through cooperation, small scale and socially embedded processes with place attachment, a TBL is considered reasonable. On this premise, Etzkowitz and Zhou (2017) in Mitra emphasise the notions and linkages between institutional actors to build entrepreneurial capacity around industrialised activities, which points to management-led and privately owned versus community-based (Mitra, 2020, p. 355). Hence, as mentioned through new angles and strategies, strengthening labour conditions involves multiple stakeholders regards land management.

3.2.2 Agricultural value chains

In agriculture, a value chain consists of the sequence of activities that connect the production of agricultural commodities, or their raw materials, to their final consumption by consumers. An agricultural value chain (AVC) consists of various producers and consumers, each performing a specific task during the production (Devaux et al., 2018). In contrast, the concept of a supply chain is not limited to agricultural products, even though it has a similar meaning.

As a network of actors involved in the movement of goods from production to consumption, supply chains (SCs) are defined as networks. AVCs and SCs were first used in agriculture to identify the actors involved in producing and distributing typical agricultural duties at the end

of the 1970 (Devaux et al., 2018). Also, AVCs originate from their first studies by examining the activities of major agricultural commodity producers.

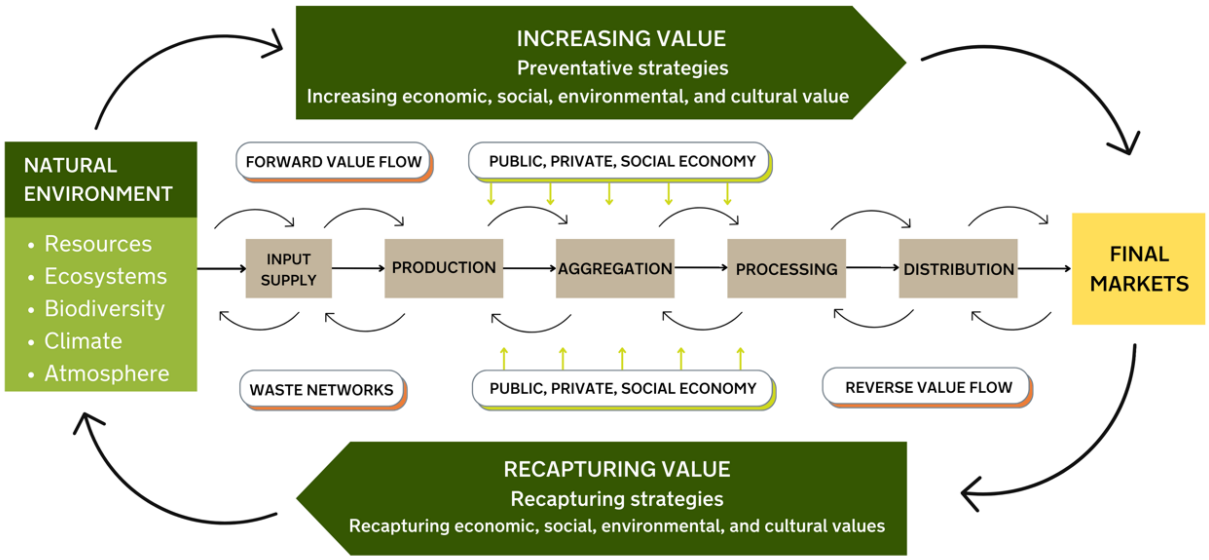

Fig.7 – *An agricultural value chain. Adopted from the Research Institute of Organic Agriculture (FiBL) and Martin Himli, FAO Rural Infrastructure and Agro-Industries Division*.

The distribution process of an AVC entails reviewing the supply chain, increasing market value, and addressing environmental concerns. Since RA crops and their outputs are diverse, Figure 6 emphasises a natural environment with a healthy ecosystem that sets the standard for long- and short-term harvesting. Waste networks are managed sustainably, and the operations have value beyond simply monetary terms since fair working conditions are considered regarding human socioeconomics. A nature-based solution like RA or agroforestry, which creates an environment conducive to different species, builds back stronger by recapturing value and continuing in given circumstances. In addition to improving living conditions for farmers and their communities, the AVC (*fig. 7)* invests in better crops as part of its continued operations cycle through aggregation, processing and distribution to final markets.

Characteristics for agriculture value chain

The activities that produce food and feed are part of the agricultural value chain. The agricultural value chain consists of several interdependent sub-value chains. The collection of activities involved in making a single product is called an SVC (Schmidt et al., 2019). A tomato SVC would include growing, packaging, transporting, and distribution. Contextually, SVCs are interconnected, which means they contribute to each other.

Our global food system can be better understood by following a nature-positive chain of command. In addition, the AVC lets us understand how food is transported, distributed, and used. We can improve and reduce fuel consumption, for example, by tracing every step through data systems. By strengthening national innovation systems (NIS), these elements will have a better chance of being operated. Here, NIS is characterised by a flow of technology and information, giving special attention to people, institutions and capabilities supporting learning at a national level (Mitra, 2020, p. 340). As well as enabling us to understand how food production, processing, and distribution affect the environment, the AVC needs actors to steer the AVC through transparent communication and integrated management so it can be measured and optimised.

3.2.3 Stakeholder management within GVC

The theory of stakeholder management is rooted in system dynamics and integrated management. Currently, it is understood as part of integrated enterprises (IntEnt) and systems thinking to solve societal and complex problems (Sroufe, 2018, pp. 28-30). Therefore, this thesis cannot be without such a fundamental understanding and concept of practicalities.

Organisations have stakeholders who are interested in achieving their objectives and who may be able to influence them in some way. Effectively managing stakeholders involves developing and implementing strategies to engage with key stakeholders. Leaders must identify, select, engage, and retain stakeholders in business and industry. The word stakeholder is derived from the term staking out. When a person stakes out the land, he puts up a marker to indicate his claim. If someone else claims the same ground, there is a dispute. Stakeholder management ensures the achievement of the organisation's objectives towards an action-learning approach. By maximising the number of willing and able stakeholders who can support the organisation's goals, stakeholder management aims to enable organisations to achieve their goals (Sroufe, 2018, pp. 60-61). On the opposite side, we have shareholders compared to stakeholders - active engagement versus passive and monetary value (Sroufe, 2018, p. 93). Generally, a stakeholder is a shareholder when actively involved with a business, for example, a customer, lead agent or strategic partner etc., with a unique, influential value.

An industry stakeholder is directly involved, such as a customer, a supplier, or a competitor, and expects the company to deliver future benefits. As the examples above illustrate,

stakeholders and shareholders are different. A government regulator, for example, is not a stakeholder because they are passively involved in a company (Sroufe, 2018, p. 124). A shareholder can also be a stakeholder, and vice versa; hence it derives from how we understand governance.

3.2.4 Multi-stakeholder governance for climate action

Sustainable development, cultural respect, and the right to life are the underlying principles of multi-stakeholder governance. Strengthening social and economic bonds requires a democratic tone and a partnership with civil society. Creating shared value (CSV) for the community, the environment, and the economy is one of the benefits of multi-stakeholder governance in agriculture. By addressing these issues through multi-stakeholder governance, all stakeholders' needs can be considered from a value-added perspective, as sketched out earlier in the integrated management theory (Sroufe, 2018, pp. 86-87). Multi-stakeholder governance is a profound and effective way to maintain economic sustainability and environmental protection in a globalised world, as it tackles sustainable value creation.

The multi-stakeholder governance approach has been widely accepted and used in the EU since the 1980s. This approach involves various actors and stakeholders to address policy challenges and develop strategies and solutions. A central element of this approach is a dialogue between different sectors, organisations, and actors. This ensures that each party feels involved and empowered in engaging stakeholders (Sroufe, 2018, pp. 87-88). As a result, multi-stakeholder governance promotes more sustainable policies, ultimately leading to a better quality of life for all.

3.2.5 Attributes of management systems integration

My theoretical review will focus on three main attributes embedded in the literature on integrated management: drivers, internal obstacles, and enablers that build upon the main theoretical models of *fig. 5* and *fig. 7;* AVC regards a systematic reviewal. Figure *7* below illustrates integrated management utilising ABCD procedures, awareness, baseline, creative solutions, and decision-making (Sroufe, 2018, p. 71).

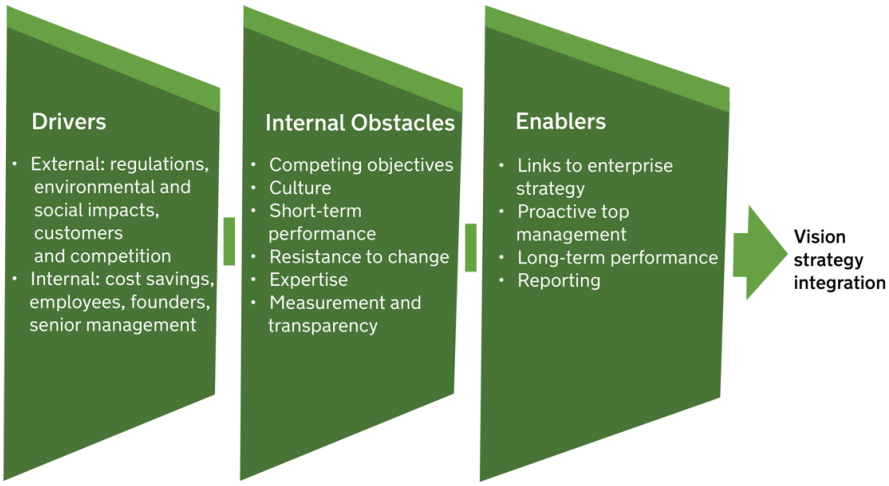

Fig. 8 – *Integrated Enterprise (IntEnt), incl. drivers, obstacles and enablers for Management Systems Integration (Sroufe, 2018, p. 188).*

A company's ability to assess material opportunities through concise action plans is crucial for staying competitive in an increasingly globalised world (Sroufe, 2018, pp. 93-94). Furthermore, culture and resistance to change are the biggest obstacles to overcome, particularly when coupled with a lack of communication channels and management support. For a company's vision and goals to be realised, its supply chain communication strategy must be clear and concise.

Companies must integrate and work together to meet market demands and internal dynamics (*fig.8*). Diversities can be dealt with more effectively by identifying the mechanisms behind successful operations and possible lagging or driving factors. This approach is more promising than reacting to market and agriculture value chain changes. A well-integrated vision strategy based on mutual benefits is essential for an organisation's long- and short-term success (Sroufe, 2018, pp. 188-191). This shapes the foundation for a well-rounded goal-setting strategy integrating mutual benefits between stakeholders in charge.

The drivers of integrated management are the main impetus for its development. Those drivers are the conditions that stimulate change and the forces that encourage individuals to pursue their interests. Action learning involves constructive critique and problem-solving by reviewing the internal or external drivers, excluding personal, organisational, or social factors (Sroufe, 2018, p. 61). Depending on the situation, the drivers may vary in strength or

weakness. A driver is also a condition that influences a person's decision-making process and behaviour, e.g. level of credible brands and technologies implemented on a project level.

3.2.6 Endogenous vs exogenous in regional development

It is essential to consider a company's assets, external viewpoints, risks, and precautions before determining a win-win strategy. By combining Dicken's GPN literature (2014) with Pike's regional development and innovation lens, identifying endogenous and exogenous characteristics in firms enhances the understanding of business development. The management and delivery of services and products are influenced by distinctive traits and features (Pike et al., 2016, p. 40). To avoid being acquired as sole small-medium enterprises (SMEs), local supply chains with scarce resources are central in negotiating more significant lead firms or transnational corporations (TNC), e.g. the consumer goods firm Unilever.

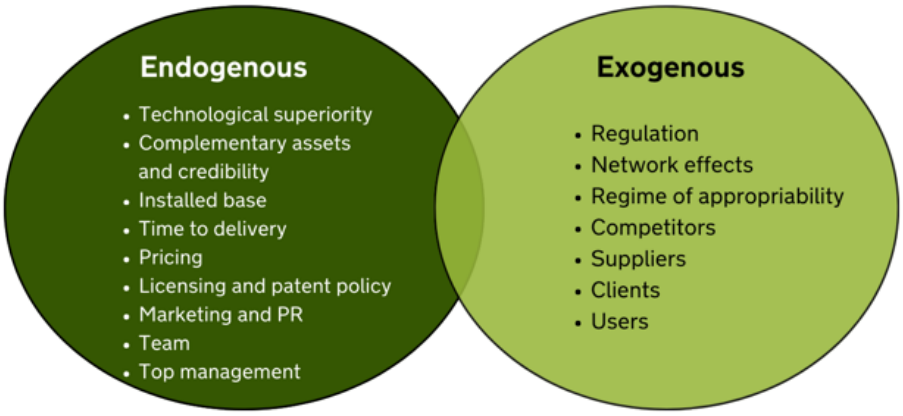

Fig. 9 – *Endogenous vs exogenous relationship on the firms' operations.*

In local and regional development, it is imperative to have a set of complementary assets, team management, and a credible approach as part of their internal (*endogenous*) factors. Hirschman (1958) illustrates the point early on a place-based system to sense policy instruments and adapt to the geographical context given (Pike et al., 2016, pp. 206-207). The external or *exogenous* side of the equation reflects network effects and regulations that may affect your client service and your competitors. In such cases, additional funding may be necessary if stakeholders have no permission. The lack of technical skills and equipment and the failure to obtain permits from local authorities may result in this. Altogether, this forms the basis of understanding endogenous versus exogenous analysis for multiple stakeholders.

As a result of adapting to challenging markets, firms may be inclined to upgrade their knowledge and innovate their spatial policy through regulations and network effects (Pike et al., 2017, pp. 116-117). First movers aim to enhance their industries' assets, capabilities, and leadership advantages through policy rationales. Establishing several technopoles, districts, and science parks enhance local and national innovation capacity to detect laggard businesses, spill-overs, and externalities.

3.2.7 The state as a regulator and facilitator

People thrive in a society where businesses are functional, stable, and purpose-driven, and the government is neutral on business issues. Using Western liberalism, the government distributes business gains to society and acts as a redistributor. In other words, it should ensure that everyone has a fair share of economic benefits by providing private payments so that profits remain in the hands of only a few people. There are different ways to achieve a level playing field. This includes upgrading information and communications technology (ICT) to intensify competition (Pike et al., 2016, p. 239). However, one of the most important ways is to ensure that everyone can enjoy economic growth benefits by sharing knowledge and building localised clusters of economic activity (Porter, 2000). If the government becomes too pro-business, society's wealth is concentrated at the top.

Transnational corporations (TNCs) should own regional assets to promote local and regional development. By doing so, they have an advantage over competitors. Regional institutions, geographically and historically speaking, are generally necessary to extract localised embedded expertise from TNCs (Pike et al., 2016, p. 241). Additionally, the national economy has a regulatory mechanism such as fiscal and monetary policies, which are designed to fix taxes and the circulation of money to, for example, minimise inflation (Dicken, 2014, pp. 184-185). As a result of macroeconomics and a particular country's international position, these are seen as exogenous resources.

To encourage further cooperation, we need to gain a deeper understanding of TNCs as development engines in regional development. The role of a TNC as a development engine still needs to be explored. By attracting and embedding exogenous resources, such as knowledge, skills, capital, and people, TNCs play a crucial role in regional development to stimulate local firms and their supply networks. Though, the characteristics and absorptive capacity of the local economy should be addressed to facilitate success (Dicken, 2014, pp.

259-260). By setting up beneficial regulations, the state can facilitate this process by integrating technology transfer strategies into the labour market strategies of employers while dialoguing with the TNC. Shortly, a long-term partnership enhances the term of deeply embedded, compared to the short-term angle of local linkages and prospects (Dicken, 2014, p. 261). Therefore, leading to greater chances of upgrading infrastructure and intellectual property for key stakeholders and community involvement. Clear communication and guidelines along the way are necessary for both grassroots levels and layers above to be heard – not pushed away.

Pike et al. (2017) state that social-ecological systems (SES) influence environmental processes. In social-technical approaches, the effects of people on the environment are integrated with those of physical systems, regards the organisation of sustainability, the act of sustainability (2017, p. 210). For instance, consider the impact of urbanisation on greenhouse gas emissions (GHG). Over the past several centuries, cities have grown in size and complexity and become major GHG. In the same way, cities and suburbs are complex social-ecological systems that combine land use, transportation, and energy.

3.2.8 Strategic coupling

GPNs and regional assets can form strategic partnerships because they have similar interests. As a result of state growth, national economic agents must develop further innovation and food security. Coevolution between state, firm and global development drives the dynamics (Yeung, 2009). One reason firms and public institutions want to partner with GPNs is to increase their competitiveness through their international presence. Providing regional assets to global lead firms can enhance unique assets.

Strategic coupling can be equated to alliances formed for mutual benefit. It may be necessary to use local knowledge while overlooking the importance of equal pay for the workforce; however, this is not a sustainable practice regarding socio-economic development over time, but it increases transaction value nonetheless regards knowledge and skills transferring (Dicken, 2014, pp. 121-122). Based on their size, type, and location, companies have a wide range of impacts on the local economy (*fig. 10*).

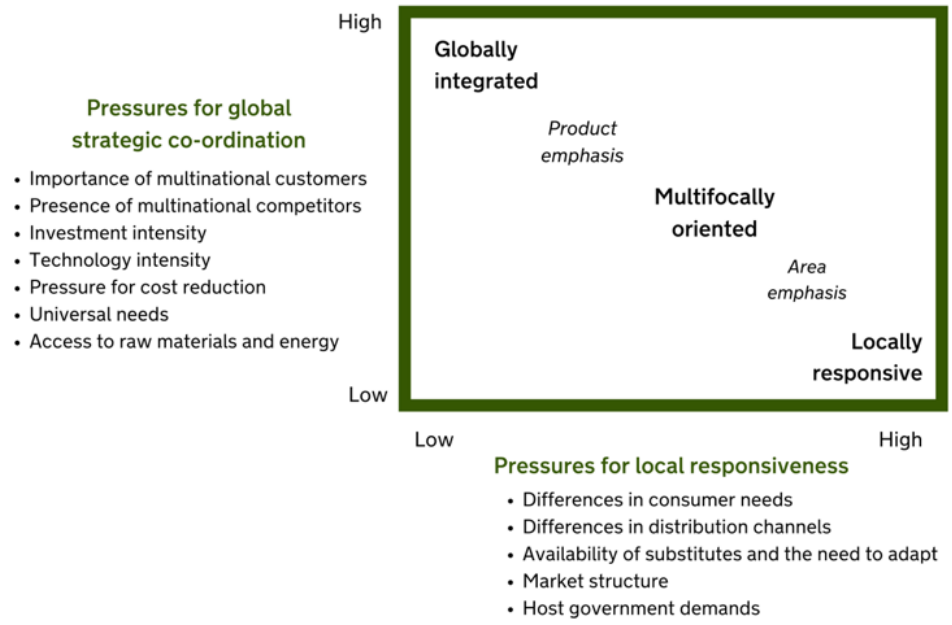

Fig. 10 – *Pressure mechanisms for global strategic coordination and local responsiveness (Dicken, 2014, p. 129).*

However, *decoupling* implies that local economic benefits are generated without the involvement of international companies in any direct or indirect way. A critical aspect of strategic coupling is that it is a form of co-development based on the degree of integration between two countries. The benefits of co-development are shared equitably.

By partnering with local or regional companies, a brand can improve its reputation, increase market share, improve customer service, and develop new products. In contrast to expensive buyouts for multinational companies, strategic partnerships can provide access to specialised techniques and innovation, increasing market share capture (Dicken, 2014, p. 141). Fig. *10* illustrates the differences in consumer needs and distribution channels along the low and high scales of responsiveness and coordination. Before we get to the traits for global strategic coordination based on investment and technology intensity, we should pay attention to consumer needs and distribution channels.

3.2.9 Standards

Innovation relies on standards to solve coordination issues, leading to network failures and market failures. It is in these situations that strategic cooperation is essential. A *standard* is, after all, a well-documented technical specification for a particular item, service, or activity with its basic dimensions and language attached, e.g. fairtrade, organic food and sustainability (Sroufe, 2018, pp. 199-200). As far as sustainability is concerned, there is a

buzzword called ESG that refers to the environmental, social, and governance aspects of managing a business. In chapters five and six, we will explore that. By collaborating and collaborating closely with stakeholders to tackle issues such as resource management for a more extended period, they are also creating a relationship between standards and steering the ship toward policy improvement and compliance.

3.3 Agroforestry and regenerative agriculture

Natural resources are managed dynamically and ecologically with agroforestry, combining trees on farms and other landscapes. Regenerative agroforestry (AF) has become a viable solution for sustainable land management worldwide due to its growing stakeholder base and past research results. This includes partnerships between public and private sectors, communities, ecologists, farmers, and indigenous groups in temperate and tropical countries. Again, these are classified as middle-level interventions based on intensive management and economic returns that may emphasise short-term to long-term benefits (Dagar et al., 2020, p. 298). Fruit trees and alley cropping have ease of control and is therefore seen as micro-level interventions, while large forest plantation is equal at the macro-level.

Syntropic agroforestry refers to the practices and philosophy developed by the Swiss farmer Ernst Götsch in Brazil. In contrast, multi-strata and successional agroforestry are often used Field (Dagar et al., 2020, p. 339) interchangeably. As a practical problem-solving approach, AF has been proven to ensure food security and rebuild rural environments. Studies have shown that perennial agroecosystems attract a good mix of fauna and microorganisms that enhance soil nutrient pools (Dagar et al., 2020, p. 242). This area's forest cover exceeds 50% on 160 million hectares. By incorporating AF into agricultural systems, environmental restoration, increased farm productivity, and improved incomes for rural residents can be achieved based on the biological aspects of soil health (Dagar et al., 2020, p. 313). Many scientific publications discuss aspects and forms of AF, indicating that the field's knowledge base is rapidly growing.

3.3.1 Syntropic agriculture and science-based measurements

A crop's growth depends heavily on soil moisture, especially when it is dry, known as syntropic. Plants benefit from a high soil moisture content by developing their roots and leaves and absorbing nutrients more effectively. Conversely, low soil moisture can lead to leaf senescence, defoliation, and death. A significant export of P occurs in harvested

products; according to Sanchez et al. (1997), there is often a problem with phosphorous, which is a crucial constraint to crop production (Dagar et al., 2020, p. 243). In this regard, soil fertility research has seen significant development, e.g. Sileshi et al. (2014) on meta-analyses and nitrogen (N) fixation of trees to support maise yields. A substantial benefit of organic inputs over inorganic ones for long-term sustainability, according to the author, is that 50-80% of N inputs applied through organic N are not utilised by the crop but are incorporated into the soil organic matter pool (Dagar et al., 2020, pp. 242-243).

A technical approach to farming systems

It is intended to advance various agroforestry techniques through applied research in the previous paragraph, which may seem technical. A further addition would be adaptive research, which would evaluate other technologies based on their location and concentration of appropriateness on the farm and review of adoption and non-adoption of technologies (Dagar et al., 2020, p. 299). Technology and people management must be integrated to seek a more innovative farming systems approach and policy put into practice with its investments. Shortly, this aims to strengthen the grassroots and local level of agroforestry and regenerative agriculture's technologies and possibilities.

In recent years, the importance of measuring greenhouse gases, carbon dioxide, biodiversity, and nutrient cycling has grown. Land management practices like agroforestry have become increasingly efficient by measuring these vital environmental parameters. Generally, monitoring equipment measures water, greenhouse gas levels, soil nutrient levels, carbon dioxide (CO 2), and nitrogen (N). The purpose of an agroforestry system is to maintain agricultural productivity while optimising the environmental quality of natural ecosystems (Fonseca et al., 2015; Dagar & Tewari, 2018, p. 709).

To make a sustainable transition, traditional firms must replace their siloed monitoring and data collection approach with one based on syntropic agriculture and outcome-based approaches (Dagar et al., 2020, p. 296). Plant health, soil moisture content, greenhouse gas levels, and nutrients must be measured to rebuild RA's ecosystem services.

3.3.2 Crop production and anthropology

Several studies have examined climate change for its impact on crops, livelihoods, and existence. Anthropology aims to understand human nature through social structures, such as

family dynamics and multi-national actors and their activities. Crop production is predicted to decrease in some cases, while crop production is expected to increase in others.

A *vulnerability is* an inability to cope with adverse climate change effects, including extreme conditions (Dagar et al., 2020, p. 217). Climate, precipitation, crop impact, aridity, and extreme weather influence predictions. Agroforestry promotion and regulation are among several concerns regarding the magnitude and direction of expected changes.

Covering cropping in regenerative agriculture has many benefits, including a positive effect on soil biology and ecosystem services. Cover crops can be used as organic mulch or as green manure. They can also control weeds and pests, reduce erosion, sequestrate carbon, and feed wildlife. Although they are most commonly planted in the spring and summer, they can also be planted in the fall or spring.

Cover crops' many benefits are improved soil structure, increased organic matter, reduced runoff, and reduced erosion. Besides increasing biodiversity, it also helps wildlife flourish, mimicking mother nature instead of tons of toxic fertilisers that provide short-term profits. Aside from combating climate change, cover crops sequester carbon while reducing the use of chemical fertilisers. Some cover crops can even be used as a biofuel feedstock, given their high biomass yield and easy accessibility of crops, as well as the ability to grow them on marginal lands. Lastly, cover crops have been growing for years but still need to be utilised on a large scale.

3.3.3 A systems-thinking approach for food security

Every action we take impacts elsewhere, whether locally or globally, as our world grows more complex. To make a positive change, we need to understand the larger picture since everything is interconnected, dynamic, evolving, and highly complex. Our current food system (FS) urgently needs significant transformation due to its considerable global and local impacts, building the case for RA and agroforestry systems.

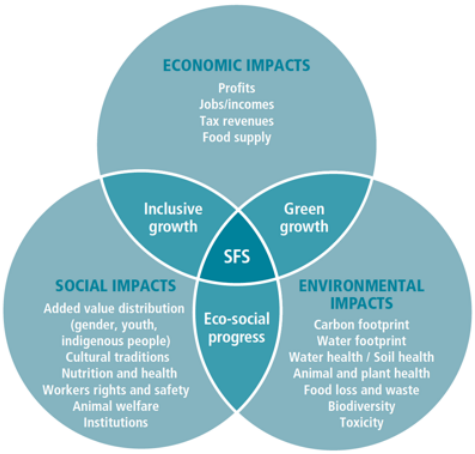

Figure 11: *The systems thinking concept consists of systems analysis and systems dynamic where feedbacks play an essential role as it influences the systems.* It is adapted *from FAO, 2018*.

As a result, sustainable food systems (SFS) require a set of locally and globally aligned actions (FAO, 2018), including an adaptation of RA to agriculture. Achieving sustainability is critical to maintaining a balance between society, the economy, and the environment. At the same time, it requires keeping the economic, social, and environmental foundations for generating food security and nutrition with green and inclusive growth for future generations (*fig. 11*). The social impacts of, e.g., gender, youth and worker's right may seem to be forgotten. By understanding the role of multifunctionality for regenerative agriculture and AFS, these systems can improve the livelihood and resilience of sub-urban areas (Dagar & Tewari, 2018, p. 711). *Fig. 11* is anchored in sustainable development goals (SDGs) and provides a framework for addressing the challenges of food insecurity and malnutrition.

Community-driven development

Community-driven development (CDD) for regenerative agriculture and its impact on the agricultural value chain has gained considerable attention since the Bill & Melinda Gates Foundation first introduced it in 2012. CDD is an approach that brings together multiple stakeholders in a community to achieve a common goal (Mitra, 2020, p. 120). The system is based on the premise that people are best able to solve their problems. CDD has been successfully applied in diverse areas, such as healthcare, education, and environmental sustainability.

Framework for RA activities related to food systems

The conceptual framework shows how multiple outcomes and feedback affect change direction. Systemic thinking would allow us to understand better how critical processes work within the FS.

We need to use a systemic approach to understand better how direction change is affected by multiple outcomes and feedback. As seen in *fig. 11* above, the FS provides a clear overview of its main activities, including value chain analysis and factors influencing social and environmental outcomes (Ericksen, 2008). According to Ericksen (2008), adaptive management allows us to understand and predict these interactions better. To manage their resources economically and environmentally, smallholders must consider their systemic implications with every business decision (Banson et al., 2015, p. 676). This is due to maximising the output from the limited resources at hand.

Research on smallholders' social welfare outcomes provides the basis for this literature review. It focuses mainly on finding off-takers and enhancing them. As well, participatory and human-centred approaches can result in more inclusive and relevant research that can also increase yields for farmers. El Tahir & Vishwanath (2015) define markets as organised acts between potential buyers regarding market demand and potential sellers regarding market supply, which enables them to trade fields (El Tahir & Vishwanath, 2015, pp. 63-64). For this, the theory of regenerative mechanisms in agroforestry and regenerative agriculture needs to be studied in greater depth.

3.3.4 Defining regenerative vs net-zero and degenerative practices

Our relationship with the land must be redefined, just as environmentalism has been redefined in today's diverse society. We must redefine our relationship with the ground, from protecting the planet to sustaining life. Our soils, air, and food system are destroyed by degenerative, destructive agriculture, and regenerative agriculture is the antidote. Thus, regenerative is used in agroecology and permaculture to describe a dynamic equilibrium and is seen as the most sustainable land management option compared to monoculture-based practices. Also, when practised at full scale, there are long-term benefits to reap, including social, environmental, and financial ones (Dagar et al., 2020, p. 297).

To leave a healthy environment for future generations, we should protect the land. Conversely, degenerative practices involve monocultures and tons of fertilisers, proven to be toxic to the soil over time. That may be a cause of not continuously monitoring and evaluating, then redesigning for a results-based management practice (Dagar et al., 2020, p. 298). They are used to produce food at scale at the expense of ruining topsoil—the base layer that protects crops against extreme weather and absorbs carbon and rainwater. Regenerative agriculture is, in this sense, similar to nature, where continuous improvement and adaptation to changing conditions are crucial for success. Regenerative agriculture implies a flow state, constantly striving for improvement, where further diagnostics on monoculture and restoration actions demand a strategic angle to combat, e.g. degraded land (Dagar et al., 2020, p. 323). Some define it as a set of practices and principles; others describe it as a set of outcomes.

3.3.5 Agroforestry management and service provision

An assessment of regulatory policies for advancing agroforestry is in place for proper service provision. For example, the government has to appreciate multiple ecosystem functions and ecosystem services (ES) provided by the land use system and then support this from the national legislation (Dagar et al., 2020, p. 296). Next up on FAO's (2013a) list is compensating farmers for delayed returns, based on its strengthening nature. However, the short-term economic risk is short-term for not harvesting enormous fields as monoculture does. Finally, to eliminate institutional constraints on agroforestry, those reinvest in technology and upgrade for proper monitoring and reporting (Dagar et al., 2020, p. 297). A more innovative business approach is needed for a sustainable land management option to be preferable for more farmers.

Trees and forests reduce erosion, improve soils, store carbon, provide food, fuel, and medicine, buffer extreme weather events, and enhance the air quality of human society. In addition, trees and forests are essential for human survival, aesthetics, culture, spirituality, and recreation – both on a small scale for home gardens and large fields (Dagar et al., 2020, p. 398). The rapid loss of forests due to deforestation, degradation, fires, and conversion to agriculture has forced instant adoption at alarming rates.

Plants can be used to protect and earn income in agriculture and horticulture. Agroforestry practices can prevent erosion, preserve biodiversity, and provide food and fodder for

livestock. Because soil health and soil carbon have improved (Dagar et al., 2020, p. 398), Nair et al. (2010) deliberately describe sustainable management practices such as AFS as proven. Trees, shrubs, or both can be utilised to increase crop yields in agriculture. While simultaneously preserving natural resources, the goal is to simultaneously improve crop productivity, sustainability, and quality.

3.3.5.1 Multi-strata agroforestry

There has been extensive research on trees and shrubs used in agroforestry, especially in arid and semiarid areas. In syntropic conditions, *multi-strata agroforestry* emphasises the importance of trees in improving soil fertility (Boscolo et al., 2010; Kato et al., 2010; Njoroge et al., 2011; Seifi et al., 2013). By reducing damage caused by weeds, plant pathogens, and insects, you will be able to combat ongoing pests naturally. The diversity of plants plays a massive role in enriching protection coverage because they decompose material, shade with canopies, and cover the soil with vegetation.

Dagar & Tewari (2018, p. 190) argue that multi-strata agroforestry combines trees and crops to provide shade and protect crops from heat and drought. Trees offer additional nutrients and are combined with regenerative agriculture. Despite its long history, agroforestry has been challenging. I emphasise four factors in urban agroforestry because people want to ensure the land area is environmentally and economically sustainable. Farmers and lenders can reap long-term gains from AFS investments by taking calculated risks and utilising technical knowledge. Moreover, green infrastructure linked to governance requires a holistic view to properly manage the planning and implementation processed (Dagar & Tewari, 2018, pp. 720-721). Then, these regulations still need to be cemented, meaning the government can follow intersectoral coordination with access to markets rather than sole full governance regards to access to markets and food safety.

3.3.5.2 Nitrogen dynamics in agroforestry systems

Soil nitrogen (N) dynamics are critical in controlling nutrient status, crop uptake, and growth in agroecosystems. Agronomic practices maintain the soil N dynamics (Dagar & Tewari, 2018, p. 656), while soil N mineralisation can be studied in several controversial yet diverse ways. Tree planting is an effective method of countering climate change because trees can regenerate land and are cost-effective (Hawken, 2017). In addition to supplying food and other products to local communities, agroforestry systems restore natural water systems and

provide innovative crop management methods (Dagar & Tewari, 2018, p. 270). Further, by recognising the vast need and opportunity, governments worldwide have committed to tree planting efforts, often tied to their goals around carbon emissions.

A positive landscape approach is increasingly being utilised as a part of restoration efforts and managing critical natural capital. This approach recognises the interconnected parts of the ecosystem, works with all stakeholders, and involves the local community (Dagar & Tewari, 2018, p. 264). Many tree planting schemes are monoculture-style plantings with trees planted in dense configurations, in rows, and designated to be cut for lumber in just 10-15 years. Consequently, the authors actively negate their potential status as a long-term carbon sink (Chazdon & Brancalion, 2019).

3.3.6 Ecosystem services and natural capital

Natural capital and *ecosystem services* bring many benefits, but are they the same? Understanding their relationship is crucial, especially for the environment at scale, where context matter regards adapting to, e.g. urban and rural tree sorts for agroforestry (Dagar & Tewari, 2018, p. 710). Ecosystem services and nature have become increasingly important to academics, policymakers and citizens. The ecosystem provides services that help us better manage and protect wildlife, so they deserve respect for many reasons. In that regard, as part of the UN's Sustainable Development Goals, we should prioritise and conserve critical natural capital assets like clean air, water, and soil, that we often take for granted. The three primary reasons are food security, prosperity, and environmental protection.

Moreover, natural capital provides ecosystem services that enable us to meet these goals. Natural capital is the foundation for human well-being. Natural capital is the sum of all ecosystems, including natural resources, biological diversity, and ecological processes dimensions (De Groot et al., 2003, p. 202). This includes the natural environment, living organisms, and the atmosphere, which provide essential human services, which is why it is coupled with the socio-economic criteria below.

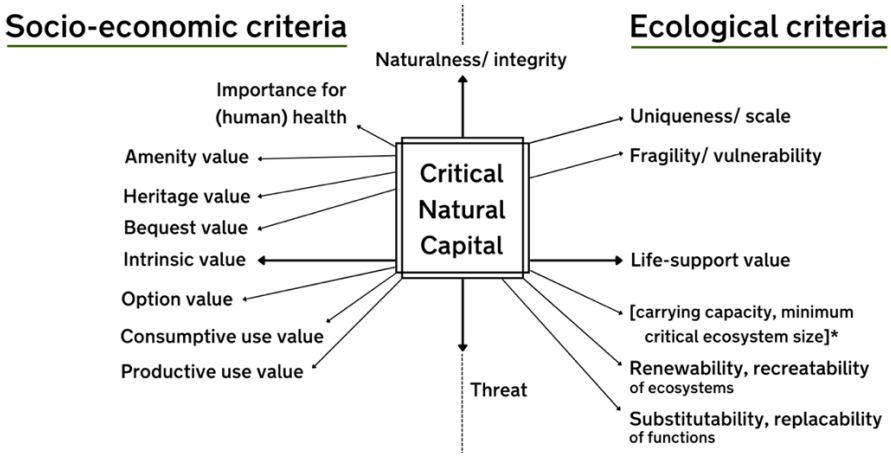

Fig. 12 – *Socio-economic and ecological criteria to evaluate critical natural capital.*

The authors propose that the concept of natural capital is a valuable tool for analysing the effects of policy interventions and should be further developed to include ecological services, such as the role of soil carbon storage. As discussed in the preceding chapters, the impacts of human activities on biodiversity are often overlooked when biodiversity is defined narrowly in terms of species counts or habitat areas. This problem is particularly evident in the case of climate change and other forms of anthropogenic disturbance.

Economic activities have significantly impacted the environment and social well-being over the last few decades. This goes hand in hand with screening critical natural capital (*fig. 12*). There will be synergetic effects among the different aspects of necessities since there is multiple dimensions (De Groot et al., 2003, p. 202). As a result of this synergy, several changes, which may not result in critical situations individually, may do so when combined. For example, the productive use value is a measure of the yields.

On the other hand, ecological criteria represent a system for assessing the value of life-sustaining resources and the likelihood of ecosystem regeneration. For a region to flourish, socioeconomic and environmental standards must work Field (De Groot et al., 2003, p. 188) harmoniously. Finally, the burden of proof demonstrates the financial consequences of preserving an at-risk species with a minimum safety standard. As the last step, the limitation of evidence illustrates the financial results of protecting an endangered species using a minimum safety standard. Despite not being as practical as the precautionary principle in conservation, the minimum secure method can reduce extinction threats. The concept can

also be applied to any natural resource or species significantly affecting the surrounding ecosystem; therefore, a proper plantation setup is a crucial (Dagar & Tewari, 2018, pp. 388-389). According to the approach, losing any natural resource will negatively affect the ecosystem around it and the species it supports.

Ecosystem services (ES)

In resilience also lies sustainability, which is often used in a vague sense to mean environmentally friendly or economically viable. Markets, rights, and identities are among the induced changes for restoration and drivers, e.g. incentives, fairness, and motivation for proper capacity building for natural resources (Sroufe, 2018, pp. 298-299). Restoration means increased functionality and reversing the experience of degradation FAO (2022). This can be added for several settings; hence it is advantageous to contextualism it to the agricultural sector given the problem statement. It helps combat *degradation* and the loss of functionality of, e.g. land or forests (Dagar et al., 2020, p. 311). Ecosystem services in agriculture development (ESAD) is a sustainable agriculture approach aimed at understanding the impact of ecosystems on human well-being. The goal is to improve agricultural systems' resilience and protect biodiversity, a growing field of study and research.

In resilience also lies sustainability, which is often used in a vague sense to mean environmentally friendly or economically viable. The induced change for *restoration* and drivers are, e.g. markets, rights and identity linked to the actors involved with their incentives, ownership and motivation. Restoration means increased functionality and reversing the experience with the degradation (Dagar et al., 2020, p. 311). The good news is that agroforestry is considered a problem-solving science with its social and ecological linkages as part of the cultivation. In the context of RA, sustainable food production implies producing food that does not harm the environment, society, or consumer health and provides producers with farmers' livelihoods (Dagar & Tewari, 2018, p. 74).

Furthermore, food insecurity and poverty worldwide lead to failures in economic development, particularly in countries where agriculture is heavily reliant. Also, in line with intercropping, agroforestry has its advantageous position of increasing ecological goods and services, bringing market value and profitable export cases. Specifically, the green services include but are not limited to bioremediation, reducing deforestation and stabilising depleted

soils from erosions (Dagar & Tewari, 2018, p. 458). Lastly, due to the combination of these elements, food production can be grown regarding ecological and social conditions.

3.3.7 The role of biodiversity and carbon sequestration in nature-based solutions

A significant contributor to greenhouse gas emissions (GHG) is agriculture. Thus, farmers can combat climate change by adopting regenerative practices that improve soil health and reduce chemical inputs while assisting their crops in growing more efficiently and yielding more. Further, I will explain in this section how biodiversity and carbon sequestration work in regenerative agriculture and how farmers can use them to reduce their environmental impact. An ecosystem consists of many species that work together for mutual benefit.

It is most effective to reduce poverty, boost food production, improve health, and reverse climate change with *nature-based solutions* (NBS). As a result, it entails the incorporation of additional species into the land-use system (Dagar & Tewari, 2018, p. 604). This nature-positive concept encompasses regenerative agriculture (RA) and agroforestry systems (AFS). NBS is best defined as a framework for creating a more sustainable society by addressing the root causes of livelihoods, food insecurity, health problems, and environmental degradation through natural solutions (Atta-Krah et al., 2004). For example, the natural solution to malnutrition in the developing world is not to give out free food; it is to give out seeds. Likewise, providing farmers access to safe drinking water is not enough; they also need access to good soil through ecosystem processes like AFS fosters (Dagar & Tewari, 2018, p. 717). Nature-based solutions include nutrition, health, green energy, agroforestry, ecosystem restoration, nature-based tourism, and agricultural extension services.

Silvopastoral landscaping is a popular system mix of trees, livestock and forage and is a popular agricultural service for the northern and central parts of Portugal. Torres-Manso et al. (2016) have researched and found that the farmers build on a mutual relationship. However, the lack of forest management and economic aspects indicates the need for monthly fixed salaries. Low production efficiency and is a heavily subsidy-dependent system. This is an essential component of the sustainability of the Natura 2000 network in Portugal, which is a network of breeding and resting areas for rare and threatened species (Dagar & Tewari, 2018, p. 328). The socio-economic evaluation, however, focuses on regenerative agriculture and agroforestry, where, for example, small-scale livestock were more normalised in the 1940s. The average farmer's age of 55 tells us that the adaptation rate and urban movers have left a

solid trace (Dagar & Tewari, 2018, p. 206). These activities are essential for landscape maintenance and the creation of product valuation and differentiation, shortening the agri-food supply chain. On top, the decomposition of organic matter, pollination of plants, seeds dispersal, and animal food provision are all ways ecosystems can sequester carbon.

3.3.8 Soil organic carbon

Living organisms produce organic carbon, while inorganic carbon includes carbon dioxide, carbonic acid, and bicarbonate. By mineralising and respiring inorganic carbon, organic carbon can be made. Fertilisers add inorganic carbon, while leaches remove organic carbon (Dagar & Tewari, 2018, p. 273). Bacteria and fungi that decay dead organic matter convert inorganic carbon primarily into organic carbon.

For various reasons, organic carbon plays a critical role in soil. If there is an excess of organic carbon, the ground can become acidic, causing nutrients, especially iron and salt, to be leached. This reduces soil fertility and adversely affects plant growth and the health of animals that consume plants. The amount of organic carbon in the soil can also affect several soil-based processes, such as nitrogen fixation, which plays its part in the transition phase and further enhances the nearby environment. However, only about 10% of nitrogen fixed by plants is used, while the other 90% is lost to the environment. (Dagar & Tewari, 2018, pp. 275-276). That is rough because plants need nitrogen to grow and produce crops.

3.4 Local and regional development

A solid local and regional development framework enables the residents' economic, social and cultural prosperity to, e.g. enhance localities such as strategic partnerships (Pike et al., 2017, p. 50). Local and regional development determines the financial strategy for securing economic growth and jobs, shaping the community and its (sub-)regions. Through a strategic approach to economic development, we identify and develop investment opportunities across the country in collaboration with local and regional partners. It is a crucial part of the Government's Economic Action Plan, building its reserves for quirky twists such as the energy market (Pike et al., 2017, p. 52). These point to hard facts, while the question of equality, power and politics seem to be more intertwined moving forward.

3.4.1 Institutional innovation and entrepreneurial capabilities

As a result of sustainability and environmental responsibility values, sustainable and ecological innovation overlap, this approach builds on the thesis of a systematic approach rather than focusing on one value in an institution.

The hybrid institution combines social and ecological factors to address problems and develop solutions. An example of institutional innovation is social-ecological projects, which build knowledge and capacity and reduce food waste. Farmers grow organic food to meet market demands. Additionally, Milberg and Winkler (2010) highlight the importance of productivity growth, chain upgrading, and embedded supply chains at the local, firm, sector (GPN), and national levels (Pike et al., 2017, pp. 244-245). As a result of empowered workers and improved standards, the GPN adds to the cost and capabilities. Governments, businesses, and civil society all play a role in it. As a hybrid institution, the GPN enables incremental and new products to foster innovation and knowledge development (Gustavsson, 2018; Dicken, 2014).

3.4.2 DUI: Doing, using and interacting

DUI is yet another Innovation and knowledge spillover that must be separated when developing paths for regenerative agriculture. The core innovation dynamics centres on research and development (R&D) and plays its part in building both the technical and social dynamic spectre given specific fundamental mechanisms, skills and variables to navigate (Pike et al., 2016, pp. 111-113). The common dominator has a robust value-added approach with interaction among actors and local cooperation between stakeholders. Thus in DUI, the network is acknowledged as an organisational mode of learning and interaction to embed methods and networks of agents for lasting change for the area and industry.

The innovation type also influences the creation and knowledge exchange; for instance, new products are more likely to be developed than new services (Dyer et al., 2015). The critical elements of DUI are agricultural research institutions and firms. These organisations provide the key input to the innovation process as they carry out the basic and applied R&D work. (Pike et al., 2016, p. 112). This work is done through agricultural research institutions or other institutions specialising in agricultural research.

3.4.3 Path dependence vs path development for agriculture

The path-dependent process is an economic outcome influenced by current conditions and previous studies. Consequently, the economy is path-dependent because choices based on transitory needs can persist long after those conditions change, emphasising the importance of technological competency as a firm's resource (Hassink et al., 2019, p. 4). As a critical institutional framework, regional investment mechanisms, such as Regional Development Agencies (RDAs), have also been identified (Pike et al., 2017). Contrary to the Global South, Northern Europe has seen an increase in links between investors, local suppliers, and research institutes (Pike et al., 2017, p. 247). Tomaney (2010) ensures that its place-based forms of regional development, e.g. modern agriculture, allow the strategising process to adapt in fast-moving markets rapidly.

A study of path dependence is essential because it provides insight into development dynamics and why countries choose specific paths (Hassink et al., 2019, p. 2). Studies demonstrate that extra-regional knowledge sources can stimulate innovation when past decisions shape the economy and are often stuck in an equilibrium (Hassink et al., 2019, p. 2). The current literature shows that a country's external environment plays a crucial role in shaping its economic development and competitiveness. The external environment consists of global factors such as trade, technology diffusion, and domestic policies (Hassink et al., 2019, p. 3). As a result, exporters will try to maintain their market share by producing competitive products, thereby ensuring future revenues.

3.4.4 The socio-technical system (STS)

Social-ecological systems (SES) are conceptual frameworks that emphasise human agency's central role in shaping the dynamics and outcomes of environmental processes. The theory of socio-technical systems. These can be anchored on, e.g. indigenous (internal) growth or endogenous. The last mentioned builds upon the growth within localities and integrates policy intervention more likely (Pike et al., 2017, p. 137). These place-based approaches have risen in popularity over the last twenty years respectively.

As with traditional ecological approaches to understanding people's impacts on the environment (Geels, 2019, p. 187), socio-technical implies that people are a part of the physical world rather than separate from it. Because socio-technical systems are intrinsically dynamic, they are challenging to manage using ecological or other 'traditional' paradigms.

Multi-scale feedback loops operate simultaneously in socio-technical systems.

Many transition studies focus on historical processes of radical change. Using these specifications, we can better understand niche-regime interactions, which are crucial for a transition's takeoff phase, when niches interact with regimes to initiate radical technological, institutional, and structural changes (Pike et al., 2017, p. 201). Time series or income and spatial distribution are examples of continuous data types. In contrast, outputs, outcomes (business R&D), and impact (gross value added) are the most critical factors in evaluating the organisation. Transition studies focus on two dimensions: regimes are defined by constraints and opportunities, whereas systems of options and conditions describe the latter.

The neo-classical theory views spatial policy in terms of economic growth. It emphasises causal actors, including individuals, firms, and governments, with an institutional focus on local disparities and knowledge dependence. A lagging region needs to take a midterm to long-term view and make more calculated decisions to become a growing region. Conversely, according to Keynesians, economies need to be understood regionally before new initiatives can be implemented (Pike et al., 2017, pp. 69-70). The region's government should be in charge of the economy, not the central government, as I market itself upon a collective approach. A regional economy is a relatively autonomous region from the centre and not directly dependent on the centre.

Using three analytic dimensions, it is possible to identify anchors that link niches and regimes and cause transitions in sustainability transformations. It is unique among sustainability transformation research to study socio-technical changes. STS involves multidimensional struggles between radical niche innovations and incumbent systems that cannot be generalised across space and time with just one size, like niches or scales. It is possible to examine the third dimension in two ways: discrete, continuous, spatiotemporal, and regime. Technology is viewed as a physical part of an organisation. Norms and conventions determine what behaviour is acceptable in society (Geels, 2019, pp. 187-188). Technology is viewed as an organisation's mechanical or physical part. The distribution and geographical systems shape, enable and underpin provision systems through regulations, knowledge, financial flows, and incentives (Geels, 2019, p. 188). Distribution and geographical systems shape, enable and underpin provision systems. Technological tools allow these interactions.

Innovation and soft resources like networks and business resources are needed to improve socio-technical systems on a local, regional, and national level. Human values and agency contribute to the complexity and diversity of socio-technical systems. Disturbance and shock can disrupt these systems and cause them to malfunction.

3.4.5 State governance

Social-ecological institutions have been a growing subject of research since the early 1990s. A social-ecological or greening institution promotes society and the environment's sustainability, where an evaluation of R&D investments, its strength and weaknesses should be monitored and reviewed (Tidd & Bessant, 2018, pp. 150-151).

Furthermore, in this project, the role of the state and civil society will be examined with the institutional framework and functioning of sustainable institutions. In this concept, GPN emphasises territorial embeddedness and social nodes, meaning how well the connections are anchored in a business process and its surrounding environment, being financial, cultural and geographical.

The long-term sustainability of institutions depends on legislation and capacity building, such as for health, safety, and the environment (Dicken, 2014, p. 408). These are also vital regards production capacity, techniques, and agro-food production circuits at a regional level, aiming to control food quality and resilience throughout the supply chain (Dicken, 2014, p. 425). To enrich this picture, *fig. 1* illustrates several central elements to navigate from the national to local level of integration to upgrade natural capital and services in sub-urban areas through innovative knowledge management, strategy, and governance. Sustainable institutions promote and support responsible living in harmony with nature and society (Dicken, 2014, p. 426). As a result of a solid and stable framework, sustainable institutions are both practical and fair, so they help to foster a healthy community.

Geographic embeddedness and decentralisation's benefits

It is possible to facilitate international trade through geographical proximity or embeddedness. Goods produced in one country can be sold in another country that is nearby and more accessible, thus minimising the marketing costs. Quality control is better, transportation costs are lower, and networks are more efficient if one can shorten the supply chain A-Z to the market (Dicken, 2014, p. 256). Further, information about local economic

costs and determining what angle and type of upgrade are required for a development to meet stakeholder interests. The GPN has central dimensions of the potential impact on local economies and practical reinvestment in fields of successful food exports, as shown in *fig. 2*.

3.5 Managing innovation through integrated management

A proper project management mindset, where strategies are fulfilled and risks are assessed, is one of the keys to success in an innovation space with many angles to tackle. The table below presents an integrated analysis of accounting enablers, drivers, and barriers to innovation.

Accounting drivers	Enablers	Analysis
Internal drivers • Decision-making • Corporate values • Profitability • Stakeholders' perception **External drivers** • FASB, SEC, GRI, SASB • Auditors • Annual reporting • Competitors • Shareholders • Activism	• Carbon disclosure project • Shadow pricing • GRI guidelines, materiality • Full or true cost accounting (SASB, IIRC) • Social cost of carbon (SCC) • Communication • Company strategy • IS/IT • ISO standards • Life cycle assessment (LCA)	• Sustainability reporting • SASB (the most detailed framework available for accounting) • GRI (sustainability reporting) • IIRC, ISO standards • Financial analysts • Emissions reduction • Environmental/social capital • Integrated Bottom Line (IBL) • Return on integration (ROInt) • UN SDGs

Table 1 – *Vital KPIs: Accounting drivers, enablers and performance evaluators to review fundamental mechanisms through proper risk management (Sroufe, 2018, p. 94).*

In light of this thesis' hybrid understanding of critical mechanisms, corporate decision-making is one of several internal drivers of increased reporting awareness. As part of the European Union's ISO standards (Sroufe, 2018, p. 151), life cycle assessments (LCA) can be used to accomplish this. This can be accomplished by assessing the current state of business operations and identifying areas for improvement, such as reducing GHG emissions in production so that the external environment is not exposed to increasingly toxic outputs. As I will discuss later, integrated management theory can enhance a sustainability report and improve a brand's image among consumers.

A company must respect human rights, protect the environment, and contribute to sustainability and social good after conducting risk assessments (Sroufe, 2018, p. 153). Not to mention, transparent reporting on an actionable agenda and Global Reporting Initiative (GRI) guidelines are part of a more viable communication to reduce emissions. Popularly, this is

part of an integrated approach, therefore a return on integration (ROInt) for each firm to be held accountable (Sroufe, 2018, p. 94) ref. *Table 1*. As a result, companies must consider their ethical responsibilities as part of their assessment of the current reality and humanity involved.

3.5.1 Documentation and measurements for policy change

Identifying the best policies is vital in changing desired outcomes. Finding and estimating the best procedures can be complex, but policy can still be altered. Agriculture policies are often changed slowly, adversely affecting people and the environment. Regional strategies, which may include several provinces, are intended to involve farmers in a particular region, unlike national guidelines, which affect all farmers. In this case, identifying barriers and drivers associated with regenerative crop production may help identify barriers and drivers. In addition, solid preparation will enhance farmers' access to new markets and credit facilities to improve production (Dagar & Tewari, 2018, p. 824).

There are one or more farms involved in a farm policy. Although policy encompasses all of these levels, it is essential to note that policies can be adopted by individuals, organisations, businesses, associations, and groups at any level (Dagar & Tewari, 2018). National, provincial, and regional differences determine whether a policy change is positive or negative. Innovative agricultural research and development approaches are necessary to meet the challenge of global food security in the 21st century. National innovation systems (NIS) are crucial for achieving this goal. Innovations must be sustained by identifying the factors that shape them, such as social and ecological factors, to have an increased competitive edge in a fast-paced agro-food industry.

3.5.2 Challenges in managing innovation networks

To take advantage of potential new markets or technologies, organisations should create a starting point for innovation networks (set-up stage). In the operational phase, networks are managed by making decisions, sharing risks and benefits, and processing information on communication and coordination once members see the benefits of each case(Tidd & Bessant, 2018, p. 277). Lastly, external networks, which enable and facilitate the move to more open models of innovation, make the finding, forming and grasping of new networks with partners to perform to support innovation.

Firstly, Tidd & Bessant (2018) present four generic approaches to network building. The batch is divided into four types of innovation networks (pp. 272-275). These include four areas: supply chain learning programs, strategic alliances, and sector consortiums for developing new agricultural delivery systems. In the third zone, multi-company innovation networks are utilised in complex product systems. In contrast, in regional clusters and best practice circles (Tidd & Bessant, 2018, p. 276), members will revisit them periodically (closure stage). By moving to more open models, external networks facilitate forming and grasping new partners to support innovation.

In addition, network formation is hindered by geography, institutions, ideology, and ethnic barriers. Apart from technological and ethnic differences, the last part results from deep-rooted cultural differences. In the context of diverse viewpoints among stakeholders, the firm's values and norms must also be incorporated into the work as guidelines for functioning and good decision-making (Sroufe, 2018, p. 323). As a result of logistics and rising discontinuities, opportunities often take much work to access.

3.6 Summary of the theoretical framework

Sustainable economic growth and environmental protection require multi-stakeholder governance. To cover the gap between theory and practice regarding scaling up RA and AFS, a hybrid system is better suited to tackle ecological and social innovation. In addition, creation is based on monitoring, evaluation, reporting, and outcomes. It should be easier to discuss the socio-economic perspective and the rich diversity of regenerative agriculture methods through a GPN perspective anchored in local and regional development.

In addition, I have included integrated management into the cases of reviewing the likelihood of successful scalation of Quinta das Abelhas for steering the complex process and its stakeholders. Besides providing adequate knowledge of the methods used, regenerative agriculture and agroforestry contribute to increased ecological innovation. Build a viable case for RA and agroforestry by mapping out vital theoretical developments.

Research and study in sustainable agriculture are growing. Agroforestry systems (AFS) and regenerative agriculture (RA) form the groundwork of a regenerative frontier that combines knowledge and technology, such as soil organic matter, as essential elements. Agricultural

systems must be resilient and protected to increase critical natural capital (CNC). For this reason, it is exciting to fulfil the research further.

4 Research methodology

This chapter presents the research methodology and discusses its relevance to the thesis context. This chapter will first discuss the research design and appropriateness, followed by data collection methods, field study and analysis. Shortly, a triangulation of mixed data material considering context, credibility, coding and documentation for all steps. Within this space, there is a continuum with the researcher's participant community and check with the supervisor (Hay, 2016, pp. 126-127). Lastly, a discussion of the research design is followed by a meeting of the potential limitations. The chapter concludes with ethical considerations.

The Norwegian Center for Research Data (NSD, 2022) has approved the thesis after successful submission. The geographical scope of the research is national, focusing on Portugal's capacity to build more robust ecological and social innovation through clever policy implementation and sustainable funding instruments. Due to the pandemic, clear communication and agreements were most useful regards respecting the involved actors.

4.1 Research design

Before choosing a research method, I will define the research field. Since the study's objective is to produce new knowledge in the field of research and provide insights into building resilience in the food system and policy recommendations, a qualitative research study was chosen (Hay, 2016, p. 217). Based on an analysis of processes in regenerative agriculture and incremental innovation, the hybrid approach to systematically upgrading the Alentejo region is used. Therefore a triangular mix of methods was logical to integrate; interviews, document analysis and observatory studies onsite, given the complexity.

The research equipment is the researcher; a genuine tone and human interaction characterise outstanding research (Kvale & Brinkmann, 2015, p. 195). These are essential traits as soft skills as part of the researcher's qualifications. Furthermore, Kvale & Brinkmann underlines specialised knowledge and preparation on the subject(s) time ahead, regards the social interaction, time and resources spent during a work day (2015, p. 203). Commonly said, the researcher and interviewee are their shared product based on the interactions.

As part of this thesis, I addressed the specific question through a qualitative case study using triangulation of data collection. When working with emerging fields, using a single qualitative study presents a weakness. The changing environment, however, makes it difficult to duplicate research. A structure for collecting objective information is necessary for building new knowledge and understanding different perspectives on reality (Presskorn-Thygesen, 2012). Given the problem statement and hybrid approach, document analysis is needed to enhance the relevance and practical value. Therefore, document analysis is required to improve the relevance and practical value given the problem statement and hybrid approach.

4.1.1 Study Approach

Agronomy research needs to be adaptive to changing conditions, not limited to social and ecological reasoning, which is why qualitative research is imperative to grasp details. With its complex environment and ever-increasing climate change, the global food system puts extra strain on businesses. Further, as the researcher, I should continuously practice self-critical ethical conduct, meaning approaching the informants, transcribing and reviewing the quality, relevance and transferability overall (Hay, 2016, p. 34).

The purpose of case studies is to study complex phenomena (Yin, 2003). In empirical research, the researcher observes and measures phenomena they observe and experience. The results remain based on the existing fence despite comparing data collected with theories and hypotheses. Unlike quantitative case studies, which are based on statistical generalisation, qualitative case studies examine phenomena or develop theories through critical thinking and reflection (Hay, 2016, p. 92). This enriches the master's thesis and prolongs the use case's sustainability. In the following section, I provide an overview of the interviews and the data collection process.

4.2 Data collection

Data collection in a qualitative setting emphasises naturalism, the idea of studying the world in its natural environment through, e.g. observation (Tjora, 2017, p. 51). I gained much knowledge from conducting onsite and digital interviews, analysing documents, and attending digital events. By doing so, I have continued to challenge my understanding of scaling up AFS and RA under syntropic conditions.

For a complete understanding of regenerative agriculture and agroforestry, I have used databases such as Google Scholar, Oria, Research Gate, Esmerald Insight and World Economic Forum Strategic Intelligence. A well-used triangulation of data, given the complex research problems of the thesis, has been crucial for my collection of second-hand data, document analysis (reports and regulations), observations, and onsite interviews.

A total of 15 semi-structured interviews were conducted with agritech, R&D, agricultural, and EU policymakers to collect primary data. In addition, I collected secondary data from relevant strategies, reports, news articles, and academic papers. To gain additional context, I attended three digital events with reNature involved, including the International Institute for Sustainable Development (IISD)'s "Trade and Sustainability Hub 2021." Additionally, I have gained a deeper understanding of monitoring and evaluation for firms and industries in the Netherlands and Portugal through my observations.

4.2.1 Semi-structured interview

In-depth interviews are divided into seven phases, according to Kvale and Brinkmann (2015): thematising, designing, interviewing, transcribing, analysing, verifying, and reporting. These stages set the scene and are utilised adequately as guidelines to ensure a suitable research approach and structure to apply.

I interviewed vital actors in regenerative agriculture and agroforestry to conduct this study. For October 2021, I explored innovation and regional development theories, among other topics, with the HQ Amsterdam office of reNature. I developed trust and improved relationships with reNature; interviewees were asked questions about how they conceived and initiated the work. These include their sense of communication with and guidance, their organisations' ecological and social practices, which make their regenerative work forestry, and how they build the movement and share their vision (reNature, 2022b). The semi-structured set-up finetunes a balance between researcher and informant while not being too loose nor too strict, which supports a natural dialogue and direction (Kvale & Brinkmann, 2015, p. 167). I built four complete interview guides, which were shaped and served language-wise, and then targeted to each informant group to easier go deeper into the material of my research question.

Furthermore, on the plot onsite South East from Lisbon, the farmers exchanged their lessons and experiences in organising forest and landscape restoration work. As an umbrella, the contextual element of language acts as a potential barrier if not fully aware of and prepared for it. Then, the ability to warm up and speak clearly without mumbling is needed, as well as a translator in required situations (Crang & Cook, 2007, pp. 48-49). I got through my contact person regarding English to Portuguese and vice versa for the farmers, which was very practical.

In-depth, face-to-face interviews provide the best conversation flow, according to Tjora (2017). Several interviews for informants 3, 4, 7 and 12 were held digitally using Microsoft Teams, so I could not read their body language. However, the interviews, which lasted between 30 min. - 1 hour 10 minutes, have almost as much relevance as the detailed and onsite interviews. That is due to proper preparations and other utilising tags and categorising the interview series to optimise the development of my thesis.

4.2.2 Conducting and transcribing the interviews

During qualitative data analysis, transcription allows the researcher to immerse themselves in the data. In particular, the purpose of coding is to identify patterns, and relations, gain a more coherent structure and facilitate optimally for further analysis and discussions (Hay, 2016, pp. 378-379). By so, descriptive codes reflect best true originality and themes, as laid out below, to navigate and enrich the problem-solving outcome of both problem statements and research questions. It is part of *grounded theory*, meaning to generate helpful information and theories from empirical data and fully understand qualitative data (Hay, 2016, p. 377). After checking the transcript with Otter to ensure accuracy and originality against the recording, I reviewed it again to ensure no transcription errors were made. In addition to enhancing artificial intelligence (AI) features, the digital tool provides meeting notes that can be transcribed in real-time.

Seven themes were identified in advance of the interviews:

a. General insight - interests, trends, previous developments
b. Land management - agroforestry and regenerative agriculture
c. Regulations - regulatory frameworks, guidance, and policies
d. Innovation and regional development - building capacity
e. Business opportunities and applications - drivers and barriers

f. Socio-economic development – social and economic conditions
g. Resource management – input/output, project, and integrated management

However, despite receiving an interview guide and consent, respondents were encouraged to speak freely and in a genuine dialogue during the semi-structured interviews, with follow-up questions from my end. This last part ensures that the agreement regarding the information presented is formalised as part of the standard requirements of ethical research methodology. As a means of facilitating data analysis, an interview guide was developed before semi-structured interviews. A portion of the informants responded to a follow-up email, including issues or ideas discussed during the consultation to capture additional insights relevant to the problem statement. I recorded the interviews to observe gestures and observations, as well as to understand the full context. This technique was well utilised during a field trip to Quinta das Abelhas, Alentejo, Portugal, to capture impressions and nuances from the researcher's humble appearance.

There was a warm and welcoming atmosphere among farmers in Portugal and informants in general, who provided lunch and constructive discussion to shape a sustainable and diverse food system. Additionally, there is important information about syntropic agriculture, its origins, and the importance of monitoring and evaluating it regularly. Interviewees provided insight into the use of intelligent sensors, the work environment, and the lack of organised farming in other countries. Aside from getting enriched information on multi-stakeholder practices, I also found out how their organisations explain their environmental rules and contribute to building movements, e.g. nutrition-rich multi-strata agroforestry and actively held workshops.

4.2.3 Qualitative interviews: A structured approach

An interview guide usually contains three sections: an introduction, reflection questions, and rounding questions. A spike is observed at the beginning of the study, but it declines as the study progresses, accompanied by a natural warm-up (Tjora, 2017, p. 147). A practical rule of thumb is also helpful for introductions, especially for participatory observation (Kvale & Brinkmann, 2015, p. 176). Shortly, hinting towards the researches role as authentic, thereby handling the diverse informants is about a narrative of dialogue and level of subjectivity.

A good interviewer should only request one or leading questions simultaneously (Kvale & Brinkmann, 2015), so I avoided it. On the other hand, according to Kvale and Brinkmann (2015), good listening and following-up questions are noteworthy characteristics and the ability to evaluate truth-reflective questions. In addition, I tagged the follow-up questions with keywords that appeared throughout the interview process to handle the complexity of the subjects. Throughout the interview, keywords were used to classify the follow-up questions to manage their complexity. Personal interviews can last much longer than telephone interviews (Frey, 2004; Bryman, 2012), whereas telephone interviews cannot last approximately 20-25 minutes. As a result, the researcher can set aside about 45 minutes for follow-up questions related to nature after agreeing to a time frame.

4.2.4 Informants and sampling

I conducted the semi-structured interviews in three main rounds; October 2021 in Amsterdam at the HQ of reNature, secondly during the winter and early spring of 2022, and then thirdly August 2022 in Portugal. In my second field assessment and international trip, I intend to discover more gems concerning scaling up regenerative agriculture while integrating socioeconomic factors.

The reason was due to the pandemic, economic reasoning, heat waves and ongoing clarification with the handful of selected informants. Nevertheless, the upside was to absorb all information, optimise it for further preparation, and uncover potential gaps in my innovation-based angle for the research period. I conducted the semi-structured interviews in three main rounds; in October 2021 in Amsterdam at the HQ of reNature, during the winter and early spring of 2022, and in Portugal in August 2022 (reNature, 2022b). I intend to discover more gems about scaling up regenerative agriculture while integrating socioeconomic factors during my second field assessment and international trip.

In addition to a pandemic, economic reasoning, heat waves, and ongoing clarifications with selected informants, the reason was unclear. Despite this, I absorbed all information, optimised it for further preparation, and discovered possible gaps in my research-based innovation angle. My second field assessment and international trip to uncover more gems regarding regenerative agriculture while involving the socioeconomic spectre for communities to thrive.

INFORMANT 1	INFORMANT 2	INFORMANT 3	INFORMANT 4	INFORMANT 5
Regenerative agriculture firm	Regenerative agriculture firm	PhD Researcher: EU Taxonomy	Farmer	Farmer
INFORMANT 6	**INFORMANT 7**	**INFORMANT 8**	**INFORMANT 9**	**INFORMANT 10**
Regenerative agriculture firm	Technology firm	Farmer	Farmer	Farmer
INFORMANT 11	**INFORMANT 12**	**INFORMANT 13**	**INFORMANT 14**	**INFORMANT 15**
Regenerative agriculture firm	Technology firm	RA consultancy	Agroforestry land manager	RA Workshop manager

Fig. 13: *Informants represented in the empirical case study.*

To cover the nodes from local to national and international upgrading of RA, I invited a fair representation of informants, ref. *fig. 13*, which strengthened my understanding of bottom-up and vice versa. All the informants were sent an email with an interview guide and consent scheme from NSD, the national ethic organ for all research, based on their likelihood to contribute. Regarding the flow of language, I had my contact person onsite, Quinta das Abelhas, translate. An exciting experience in 30-35 °C degrees, but necessary to capture the characters and the grassroots perspective. Furthermore, these participants understand how the industry is governed and regulated internationally and nationally for regenerative agriculture investment cases and scaleability regarding awareness.

All fifteen interviews were transcribed to sort, organise, and code the collected data. In addition to providing a more profound and contextualised understanding of the content of the interviews, transcription also helps identify possible researcher biases (Bryman, 2012). As a result of tracing the discussions, I became more familiar with the data, which made it easier to identify critical themes. Consequently, I became more aware of the similarities and differences between the participants. Although transcription is time-consuming, it takes significantly longer than expected to complete.

Transcripts of interviews generate more data to be analysed ((Bryman, 2012, p. 484). It is recommended to transcribe data during the analysis process when there is a large amount of data to explore. This was done during this thesis, dealing with three primary interviews. Over the course of my master's thesis, this work method allows me to gain a deeper understanding of emerging and exciting topics.

4.2.5 Constructive reflections on fieldwork

After initially intending to meet the workshop leader at sight eight months earlier, I was granted permission to meet in person in August 2022. Due to the low number of Covid-19 victims and r-number (infection rates) in the autumn of 2021, I conducted interviews in Amsterdam, Netherlands. By assessing Norway's Ministry of Foreign Affairs (2022) and the Netherlands' and Portugal's country profiles beforehand (Our World In Data, 2022), I calculated health measures for the trips in combination with my green Covid-19 pass to showcase. This illustrates that field trips are complex, especially to foreign countries.

Due to pandemic concerns, I was rejected for Portugal in January 2022. However, I continued learning about strategic partners like Farm21, and I became fascinated with precision farming and remote farming as they continue to improve. I developed a one-week field trip plan by reconnecting with the operations team and gaining hands-on local knowledge after my main contact person at the Amsterdam office resigned from his position at the end of January 2022. Thus, I completed the second and third rounds of interviews, allowing me to adjust to the context and environment with respect. This illustrates the uncertain terrain a researcher may face when conducting qualitative research, where project planning and patience are critical assets in the process.

I travelled and conducted semi-constructive interviews in the second half of October 2021. This lasted for two fascinating weeks to build trust and relations and gather critical stakeholders to the project regarding management and reNature's vision of mainstreaming RA. Also, this was to show the seriousness of respecting their busy B2B relations and business philosophy, anchored in monitoring and evaluation in real-time through data platforms and other information and communications technology (ICT). They shared an office with a technology firm to serve on-demand needs in a business setting. Thus, on my first day, I was handed a non-disclosure agreement (NDA) to comply with rules and guidelines. This was the first of three interviews; hence, I prioritised reflecting and reviewing constructive notes, contextualising tags, and keeping a personal diary.

Figure 14: *August 2022. Fieldwork on-site Quinta das Abelhas, Alentejo region of Portugal. Farm21 intelligent sensors for measuring top and below the ground.*

From a rural area in Portugal (Fig. 14), I could adjust to a virtual tour using 4G video sharing. On the other hand, Durham University professor Darling emphasises that establishing emotional connections, building trust, listening, asking questions, and persisting in research are required (Darling, 2014, p. 202). Due to human relationships, languages, and ethics in practice, fieldwork is more than simply collecting data and information. Finally, August 2022 was here, ready to absorb the Mediterranean climate and dig deep into the monitoring and evaluation (M&E) of syntropic agroforestry and RA. In addition to sequestering carbon, reNature brings over twenty species to life while working with nature, e.g. citrus fruits (reNature, 2022b). Quinta das Abelhas is rooted in being a hub for bees for its fruitful and prosperous selection of species, e.g. pecan, peach, mulberry, grape, and aromatic herbs amongst the traditional oak pastures.

I stayed in Lisbon, Portugal, for one week, allowing me to commute forth and back for four regular work days to the central region of Alentejo. The weather delivered an average of 30°C and 37°C at most, signalising the dire conditions land and its owners must tackle. I was enthusiastically shown around and explained the various crops and how AFS works hand in hand with regenerative agriculture, e.g. cover crops, no tilling, and fertilisers, using specialised machines. Thanks to the informants, with these farmers onsite, I learned more about multi-strata agroforestry in practice. It is an agroforestry system that addresses soil and nutrition issues by focusing on potentially toxic soil environments. Also, it was of substantial practical value that the workshop leader patiently translated from some Portuguese-speaking workers, guiding me in explaining pruning—a horticultural practice involving the selective

removal of specific plant parts. As a mutual service, I naturally share the outcomes in exchange for my master's thesis findings and cross-check references to help solidify my findings – aiming to strengthen the project and give aspiring farmers practical insights.

4.2.6 Innovation in precision farming

With Farm21's intelligent sensors, reNature and connected partners can gather data above and below ground level, measuring soil health (2022), thanks to incremental innovation. A variety of frequencies are identified by listening to the bioacoustics of the earth. The collected information is then sent to the Farm21 app, which is analysed and displayed in an easy-to-understand format.

This facilitates information gathering in real-time and is a neat feature to optimally collaborate with the other strategic partners to enhance the outcome. Furthermore, several workshops are held yearly to upgrade the knowledge and educate the farmers. This is partly reNature business model to facilitate paid workshops, giving the farmers and future generations a sustainable livelihood and practice for increased yields. Also, it is vital to monitor and evaluate consequently due to the ever-threatening evolvement of rising temperatures (*fig. 15*) – a risk to humans and critical natural capital.

Figure 15: *Documentation of August 2022 | third heatwave. Monoculture focused on one crop at a big plot, plus the severe risk the Alentejo and surrounding regions are to extreme heatwaves and fire in Portugal.*

The suburban areas of Alentejo caught my attention during my time off the farm, e.g. these simple depictions of urgent dry fields. As a result of overgrazing and climate change,

agricultural systems have degraded in Alentejo. I was told by informant 15 that the Alejento region is divided into four areas: Alto Alentejo, Alentejo Central, Baixo Alentejo and Alentejo Litoral. This valuable reference compares non-regenerative farming (monoculture) and regenerative farming (polyculture). As an outsider, I was interested in learning more about polycultures' social and ecological value as part of the main objective of the thesis.

4.2.7 Participatory Action Research (PAR)

As part of PAR, the researcher emphasises the context in which the research is conducted better to understand the participants' experiences of places and events. Maintaining a balance between other subjectivity and objectivity during the project is essential - a resource for a more profound understanding (Crang & Cook, 2007, p. 13).

My visits to the Portuguese farm stretched over four weekdays of visiting. Here I were commuting from Lisbon centre, and therefore not seen as partial participation, e.g. living directly onsite. Though participant-as-observer is the correct form, given the humble figure of the researcher onsite to grasp knowledge and realistic situations throughout the study period (Hay, 2016, pp. 320-321). It is essential to review notes critically as a researcher, given that viewpoints may be influenced by consciousness, field notes, transcriptions and evaluation (Tjora, 2017, p. 91). Informed farmers or groups should be able to capture data and details if note-taking does not disrupt their workflow. The following techniques were utilised during the field assignment in Portugal: in-depth interviews with the participants, photography, documentation of the informants' experience and participant observation in the participant's environment.

The following techniques were utilised during the field assignment in Portugal: in-depth interviews with the participants, photography, documentation of the informants' experience and participant observation in the participant's environment. In this case, interpretation is the process of making sense of the data through the interpretation of the data (Crang & Cook, 2007).

4.3 Cost structure of the field assessments

A 60 points master thesis is not fulfilled for free, given both monetary and non-monetary assets, such as field trips, books, software, documentaries and travels. I have worked tirelessly part-time and in the summers to cover the costs solely below.

Return flights (Amsterdam | Lisbon)	8000 NOK
Food	5500 NOK
Literature	16200 NOK
Lodging (hostel, hotel)	9300 NOK
Microsoft Office incl. NTNU	0 NOK
NTNU admin. student fee	1920 NOK
Public transport (bus/tram/boat/bicycle/train)	2970 NOK
Software (Adobe Creative Cloud)	950 NOK
World Economic Forum | Strategic Intelligence	610 NOK
Total	**46369 NOK**

Table 2: *Calculated costs for the project period.*

With custom graphics and a keen eye for detail, Adobe CC has helped me illustrate and demonstrate my points more quickly. I could have done my due diligence on the figures in *table 3*, with the deadlines for research grants being in February, six months before the thesis' official start date of mid-August 2021, to apply and successfully save costs in the aftermath.

4.4 Document analysis

An analyst analyses the meaning, structure, and content of a document. Kvale & Brinkmann (2015) conclude that similarities and differences exist in a particular research area after interpreting information and processes. The analysis aims to understand the document's intention or content (Bowen, 2009). Supporting documents are required for the research to be credible. In this understanding, information retrieval is retrieving, arranging, and delivering information (Bowen, 2009) and identifying relevant agricultural, agroforestry, food security, and innovation documents required cross-checking databases. To illustrate the centring of current regenerative agriculture policy recommendations and regulations, a handful of records got selected.

4.5 Analysis method

It is essential to have a mix of top-down and bottom-up strategies to uncover hidden data or gaps in silos. To develop economic capital and build natural means, I emphasise the ecological and social aspects of regenerative agriculture, with help from incremental innovation.

Using the classic GPN framework, I emphasise food security and agricultural value chains (AVC), emphasising territorial embeddedness in local contexts and its strategic connections regards agile governance and the regulatory mechanisms (Dicken, 2014, p. 408). In addition, data may overlap several positions, making the research challenging. Besides helping businesses navigate the short-term vs long-term thinking of the industry, the researcher first needed to understand each process. RA requires a system to code data and connect it to the appropriate analysis function.

By emphasising the ecological and social aspects of regenerative agriculture, I help build natural capital and economic capital. The classic GPN framework emphasises food security and AVC, emphasising territorial integration in local contexts and strategic connections (Dicken, 2014). Data collection must be arranged according to the researcher's selection of the most relevant function. It can also overlap several positions, which can present some challenges. According to RA, data must be coded and related to analysis functions in practice. This was my key to understanding the AVC model set.

4.6 Research design quality

To conduct effective research, a researcher must first become aware of themselves constructively to conduct effective research. Research on agriculture's transition to sustainability requires a theoretical perspective on the agricultural value chain within GPNs and production circuits. Discussion of methods (Yin, 2003; Bryman, 2012) will be essential in future research. The theoretical perspective of agricultural value chains within GPNs and production circuits (Yin, 2003; Bryman, 2012) can also be helpful for agriculture's sustainability transition phase. Agricultural development depends on policies, institutions, practices, and technologies and provides insight into the interconnectedness of value chain approaches and GPNs.

Validity

The integrity of its conclusion determines an investigation's validity. A researcher's internal validity is determined by the extent to which the researchers have used the collected data to establish causal relationships (Bryman, 2012, p. 47). This thesis becomes more valid internally by triangulating it.

According to Yin (2003), external validity refers to how generalisable the findings are. The conclusions and cross-checking of thematics, I could trace the conversation more accessible when the interviews were done by managing the conversational flow and ignoring the temptation to tick off quickly (Crang & Cook, 2007, pp. 70-71). In light of its anchoring in outcome-based approaches and partnerships' connections, the thesis has a fourth aspect of pragmatic validity. In the literal sense, verification motivates us to achieve our goals by encouraging us to act. The objective truth relationship in scientific discourse means that knowledge is acted upon and taught in the same way as learning is acted upon, i.e., the effectiveness of knowledge reflects the point of action.

Reliability

Three factors determine the reliability of a measure: stability, internal reliability, and inter-rater reliability. To ensure the results do not fluctuate over time, inter-rater reliability is crucial for assessing a measure's strength (Bryman, 2012, p. 157). When subjective judgment is heavily involved, informants may need to make more consistent decisions when recording observations or categorising data. It can be a problem in content analysis, where media items have to be classified, or in structured statements, where observers must determine how to strategically different behaviours like those on Quinta das Abelhas' plot. This field diary enables contextual analysis.

As the researcher understands the interviewee's views, the interpretation is primarily limited to the interviewee. Semi-structured interviews categorise the interviewee's opinions based on the interviewee's understanding (Kvale & Brinkmann, 2015, p. 241), which was the source of the opinion narrative. Critical understanding relies on common sense and theoretical knowledge and anchoring this given context and problem statement with meaning. This acts as a compass for the researcher, enabling them to develop understanding independently and deeply over a long time horizon.

4.7 Limitations

The inclusion of document analysis allowed me to expand my knowledge of regenerative agriculture and then narrow my focus on the thesis, despite my limited understanding of it before. A bias can influence the analysis results in data selection after tireless work is put into the analysis. Compared to documented field trips, it is a cost-alternative way to capture data (Bowen, 2009, p. 31).

In contrast to other qualitative research methods, document analysis is non-reactive and counters reflexivity concerns (or lack thereof). Documents are stable, a corollary of being non-reactive. Because the document is being observed, it may proceed differently. Choosing the correct document type depends on the research question. Further, the investigator's presence does not change the research subject (Merriam, 1988). The fact that documents include exact names, references, and details of events makes them valuable (Yin, 1994; Bowen, 2009). A strength cited by some scholars for document analysis is that it allows for the inclusion of previously uncollected data (Holtz, 2010). Nonetheless, data collection remains the researcher's responsibility, whereas document analysis can be time-consuming, especially when there is much material. The selection is laid out in Appendix C and colours the following chapters regarding captured insights and data points.

4.8 Ethical considerations

According to NSD guidelines, each informant has been given a number (NSD, 2022). Each informant's identity is kept confidential, and data is handled in compliance with privacy laws. Additionally, participant names were retained separately, and the data was stored externally. Therefore, precautions are taken to minimise this risk, such as cloud storage through OneDrive, with which NTNU has an agreement, among others. Information can be traced back to informants if necessary. Afterwards, the consent form explained how informant confidentiality would be maintained concerning every informant and firm overall.

Whether the interviews were conducted digitally or in person, I sent consent forms in advance to selected informants. Before recording, the interviewer and interviewee were asked to provide oral consent to ensure they understood the terms and conditions. The following aspects of privacy were explicitly respected: Correctness (§5.1.d), integrity and confidentiality (§5.1.f) and security (§32), presented by Lovdata, the Norwegian law force platform (Lovdata, 2022). By doing so, professionalism and a researcher's ethics are well integrated.

5 Empirical analysis

Aside from analysing the voice and work of reNature in regenerative agriculture, this study examines how Quinta das Abelhas can be scaled up in syntropic environments. For this project-level investment in Portugal, a risk and opportunity analysis of the agricultural value chain is conducted while uncovering the drivers and barriers for the methods utilised (Sroufe, 2018, pp. 94-95). In addition, my systemic model emphasises social and ecological innovation through bottom-up and top-down approaches.

For this part, I will conduct an agriculture value chain analysis anchored in local knowledge to address the output-focused tasks. In addition, I evaluate the risks and opportunities associated with adopting new agricultural technologies. Several factors can influence the development of innovative farming practices and entrepreneurial activity. In addition, farmers' cooperatives support agricultural research and development by developing farm-based entrepreneurial networks, establishing agri-food industry clusters, and implementing public procurement schemes. Consequently, the hybrid perspective feeds into local and regional control, administrative efficiency and policy innovation. Furthermore, these countries offer many examples of institutional innovations and good practices; however, they must be fully integrated into national policies.

5.1 Defining the regenerative agricultural business case

I discovered five underlying principles in reNature (reNature, 2022b). Increasing biodiversity and farmer incomes requires enriching soils with organic matter and biomass. In addition to ensuring food security for themselves and their communities, farmers must cultivate food crops to ensure climate resilience. Because of this, reNature shares the techniques with his neighbourhood community network of farmers, making the project economically feasible and ensuring long-term success.

Many actors, institutions, values, and technologies participate in social and ecological transitions and interactions across sectors and scales. Smallholder farmers are more likely to gain market access and maximise harvest ROI during society transitions. Given the hybrid approach, modelling approaches may benefit from further maturation and broader adoption. Models can be used with remote sensing data to estimate soil carbon stocks and carbon

fluxes; for example, informants 9, 10 and 14 emphasise the value of mimicking nature.

"*The best way to improve our land's productivity and link the environment and the economy is through agroforestry." (Informant 14)*

While mitigating climate change, the goal is to increase agricultural productivity and food security. A community-based, participatory project, Quinta das Abelhas aims to promote environmentally sustainable production practices and build farmers' capacity (reNature, 2022c). Through reNature, agriculture practices, livelihoods, and the environment will be affected over the long run.

As explained by the sustainable agriculture advisory firm reNature, vast gains can be achieved by incrementally adjusting practices. Regenerative farming practices improve soil health, agroecosystem resilience, and profitability, in addition to reducing synthetic inputs and tillage costs (reNature, 2022c). In nature, plants cover the soil permanently, a characteristic of healthy soil that grows and performs well due to its natural symbiosis with microorganisms. Agriculture violates these biological principles by leaving the ground bare for several months. In addition to maintaining soil structure and nutrients, cover crops recycle nutrients and accumulate organic matter, which is gradually released by cash crops the following year.

In contrast, monoculture farming systems quickly become fragile, resulting in a loss of efficiency and profitability, whereas agroecosystem resilience is based on diversity and complexity. In addition to improving soil structure and pest and disease resistance, a diverse crop rotation improves water retention (McLennon et al., 2021). Aside from the diversity of space, we also emphasise the variety of time: the succession of cash crops, cover crops, and temporary pastures over time.

5.2 The regenerative, net-zero and degenerative practice

Agricultural innovation and farming practices can help farmers improve efficiency and reduce the use of natural resources to meet the world's food, fuel, and fibre needs. Due to the growing demand for nutritious food, agricultural sectors face challenges. Food producers have focused on cheap calories for many years and high-calorie foods to support TNCs. For example, Mcdonald's has outpaced healthy, nutritious foods in supply. Informants 1, 6 and 11

are eager to upgrade onsite, as it is well documented that the quality of our diet has deteriorated over time in the developed world.

Degeneration	Sustainability	Regeneration
• Net negative • Shareholder centric • Short term • Business as usual, Green • The goal is growth at all costs • Competitive • Parts, silos • High centralization • Data hoarding • Laws & regulations • Unicorns • Ego • Growth • Organizations-as-a-machine • Human-centric • Deplete, Deforest, degrade	• Net zero • Partner centric • Midterm • Less harm • Do more with less • Collaborative • Counterparts • Retrofitted • Data fragmentation • ESG / CSR • Gigacorns • ECO • Prosperity • Organization-as-a-family • Human-Planet centric • Reduce, Reuse, Recycle	• Net positive • Stakeholder centric • Long term • Restorative, Regenerative • Do better with less • Interdependent • Whole, systems • Decentralized • Distributed data • Beyond SDGs • Zebras • Seva • Thrive • Organization-as-a-living system • Planet centric • Rethink, Restore, Replenish

Fig. 16: *A practical comparison between the three levels to discuss climate and environmental insights.*

Degenerative agriculture destroys the soil over time with its pesticides, short-term thinking and degradation as a result, while regenerative farming activities build it up - naturally. Silo thinking, high centralisation, and short-term thinking of putting back profits into shareholder pockets are limited ways of thinking.

“The main problems with agriculture today are environmental degradation and food shortages. With the third heatwave this summer, I am seriously stressed out for the other farmers I know, as soil depletion leads to erosion and loss of nutrients.” (informant 5)

Easy choices come quickly, especially given the vast amount of alternatives in suburban and urban areas, compared to the rural site at Quinta das Abelhas. As discussed earlier, there is a dissonance between what is best for the business and the climate. The solution to these problems can be found in switching from monoculture to polyculture, which involves cultivating more than one crop simultaneously (Rhodes, 2017). The lack of sustainable food production methods and unsustainable farming practices are responsible for these problems. In polyculture systems, crops are grown together, increasing biological diversity. Christopher

J. Rhodes describes it as part of a strong network of ecosystem services, with site-specific tasks such as supporting nutrient cycles and crop-pollination (2017, p. 14). As a result of diversity, pests and diseases are less likely to destroy entire crops.

Global warming is caused by degeneration, which pollutes the land, takes up more water than it can replace naturally, erodes topsoil, and releases carbon dioxide into the atmosphere (IPCC, 2022, p. 9). Many farm sites practice traditional farming methods without realising that they disturb and destroy soil health over time. Net-zero focuses on improving soil and improving the environment for long-term solutions. In return, less productive and healthy output and degraded lands (White, 2020, p. 3). In the future, agriculture will combine modern agricultural techniques with holistic practices to create healthy soil.

Based on ecological and biogeochemical principles, regenerative methods consider environmental, cultural, and health conditions and people's well-being. A regenerative agricultural system meets food, fibre, fuel, and feed needs by integrating conservation with production. Humans sequester carbon by contributing more to soil, land, and water than they take, contributing to, e.g. SDG 13 and 15, climate change and life on land (Eakin et al., 2017). It is a stakeholder-centric and long-term-based methodology, considering all stakeholders, not just those who can afford to pay. It also considers social, economic, and environmental aspects of the environment. Regenerative agriculture requires a paradigm shift in our thinking, but it is becoming more mainstream, as is reNature’s aim.

5.3 Historical developments of agriculture in Portugal

The Portuguese have a rich agricultural heritage as one of the first countries settled by farmers, and their culture and society are rooted in Portuguese farming. A rich natural system worth taking care of, according to informant 15, hence working intensively on his craft. Since the late nineteenth century, when protectionist policies promoted food self-sufficiency, Portuguese landscapes and rural areas have been shaped by thousands of years of human activity.

During the Estado Novo regime, many central agricultural policies were implemented, including wheat campaigns, internal colonisation, irrigation systems, and reforestation. If we were to navigate 82 years back to the 1960s, rural exodus mainly occurred and resulted in the depopulation of 80 per cent of the country (Yeung, 2009). In comparison, in today's

Portuguese society, less than 20 per cent live in the interior, presenting enormous socioeconomic challenges. In recent years, new trends have emerged based on land concentration and super-intensive monoculture, which are incompatible with the goals of national and local governments.

Fast forward to the modern age of 1970, wildfires and burnt areas have increased significantly in Portugal and other Mediterranean countries. The number of ignitions and the percentage of regions roasted in Portugal is the highest despite periods of lower burnt areas (Nunes, 2012). There is no doubt that forest fires contribute to soil degradation and desertification (Moreno, 1989; Vallejo, 1997).

During wildfires, vegetation cover significantly affects erosion risk in mountainous areas. Shakesby & Doerr (2006) state that wildfires can significantly impact hydrological processes. As the canopy stores less water following a fire, raindrops are likelier to fall on bare soil. Mudflows and flash floods are particularly problematic during wildfires. Burned catchments have higher hydrological risks than unburned catchments (Meyer et al., 1995). Furthermore, the increase in deforestation has had a significant impact on the soil quality and the quality of water resources.

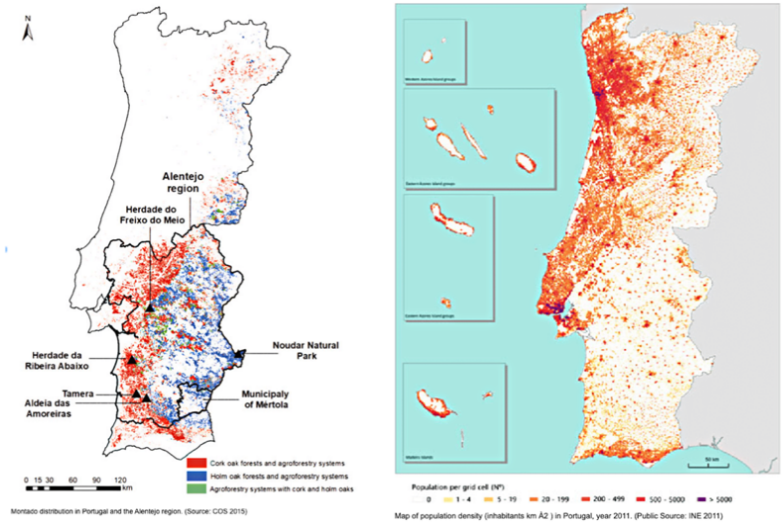

Figure 17: *Historical developments of montado distribution and Portugal's population (COS 2015; INE 2011). Also, note Alentejo and its surroundings of AFS.*

Agricultural production in Portugal primarily focuses on producing food and animal feed for export. Several crops are grown in Portugal, including wheat, barley, and other grains. Olive oil and wine are also produced in abundance. Further, a key component of Portugal's

economy and society is agriculture, which contributes about 9% to its GDP and employs about 2.45 million people (Almeida, 2020). These are managed nationally, by each EU Member State, based on Partnership Agreements and strategic plans outlining the country's goals and investment priorities.

Reinvestments in Portuguese land management

The Portuguese government invests 10% of its budget in agriculture. A third of the active population working in agriculture should ensure sustainability and competitiveness. About 20% of the country's workforce is employed. Towards these objectives, the Cohesion Fund, the Structural Fund, and the Rural Development Programme are essential. Further, approximately 2.6% of Portugal's EU budget comes from Structural Funds, while Cohesion Funds provide about €4.4 billion (European Commission, 2022a). A member state's needs are taken into account when allocating funds. Then this (re)invests in infrastructure, education, environment, and research.

"Funding is one of the most critical elements for me and the others as farmers here at Quinta das Abelhas. It is hard to harvest substantially without the measuring mechanism, tools, and infrastructure. Plus, the knowledge required and to be distributed across." (Informant 10)

On a national level, the agreeing nod by the farmer said it all. Infrastructure and food investments are hugely important, which is why the Portuguese Agricultural Fund (PAF) supports agricultural development in Portugal, with a budget of €5.1 billion. Doing so is a minor step to contribute to other GHG gases (Dagar & Tewari, 2018). To promote rural development, the fund provides financial assistance to agricultural cooperatives and farmers to acquire new technologies and implement sustainable production systems. Finally, the PAF supports investments in land management, extension services, research, technological innovations, market information, infrastructure, and training to help the rural development (ENRD, 2021). Altogether, this illustrates a clever use of network resources, value and strategy accomplishment.

According to informant eight, RA can grow in small and large environments, as he is eager to show its benefits to others. Through integrated reporting (Sroufe, 2018, p. 144). A vital element of this approach is the creation of a technical committee consisting of representatives of the different stakeholders involved in establishing a protocol for the use of agrochemicals

in agriculture. The second step is the creation of a database of farmer practices. Thirdly, creating a web platform that allows farmers, researchers, and other actors to exchange information and knowledge rapidly emphasises community-driven development of RA, or CDD (Mitra, 2020, p. 120). Further, a lot can be achieved over time by engaging the stakeholders while maintaining focus on the plot land. RA centres on empowerment and having a visible voice regarding how to shape their economy and rural agricultural land.

The EU and UN are implementing top-down policy measures to create regenerative agriculture in Europe (Bergamini et al., 2013) by affecting agriculture at the supernational level. Integrated management of agrochemical residues and pesticides is also part of this approach, which involves many stakeholders, starting with farmers like informants 4 and 5, plus 14. The project also develops a new paradigm for regulating pesticides and genetically modified organisms. Some of these measures have already been adopted by European Union member states. They would encourage a holistic approach to sustainable agriculture and forestry instead of regenerative practices.

Common Agricultural Policy's influence on Southern Portugal

The European Union (EU) has been essential in developing the Portuguese agriculture sector since its inception. The Common Agricultural Policy (CAP) has been crucial in restructuring Portuguese agriculture. Although it has created a new generation of rural workers, it has also contributed to the country's current agricultural situation. The following analysis aims to analyse the impact of CAP on the evolution of the Portuguese agriculture sector, focusing on the country's southern region.

Monitoring and evaluating the process is crucial for the rest of the system to adopt, so test sites are essential. One of the most commonly used herbicides in agriculture, glyphosate, is monitored by Germany (Hornung et al., 2015). The Netherlands and France have introduced other measures, but the EU would develop a standard set of policies to transform European agriculture into regenerative agriculture. In this way, the 1 ha project at Herdade do Freixo do Meio's area is used as a pilot site for establishing a standard set of policies for transitioning to regenerative agriculture in the Europe (Commission, 2022a). A process aimed at modernising the EU Common Agricultural Policy (CAP) has been launched by the EU called the European Agricultural Policy Reform (EAPR). The EAPR focuses on three main pillars: (i) support for farmers, (ii) consumer protection, and (iii) environmental sustainability.

“By focusing on collateral policies for a strategic approach, a firm can potentially increase their PPP (private-public partnerships) in the process.” (informant 3)

Direct payments, public procurement, and rural development are the three strategic areas of the CAP. However, the EAPR will be implemented in two phases over the next three years. We are now in the second phase between 2021-2025, as the first occurred in 2014-2020 (European Commission, 2022b). As the CAP reforms seek to reduce direct payments to farmers, increase food quality and safety, and enhance agriculture's environmental performance, there is a need for a better dialogue between public and private actors. As a result, most farmers in Southern Portugal will no longer receive direct payments from 2019 onwards, the level of payments will decrease in the following two phases, organic production will no longer be supported by price subsidies in 2021, and a new system of environmental service payments will be introduced.

Portugal will reduce direct payments in the EU budget, strengthen public procurement rules, and improve system transparency. For rural development, the EAPR will focus on three priorities; favouring smallholders, promoting biodiversity and increasing the involvement of local communities in decision-making.

As part of the 1992 CAP reform, direct payments were introduced, compensating farmers for production costs incurred at the farm level (e.g. input costs, labour, infrastructure). Indirect expenses can support production activities or objectives (e.g. increase yields) but cannot keep consumption or market activities (Bignal & McCracken, 2000). Under the CAP, farmers are treated equally, but only those who receive direct payments are eligible for any other fees. At this moment, direct costs (or the first tier) are based on the farm's yield performance during the previous year and result from the 1992 CAP reform. The price is available to all farms regardless of economic status or land use, as it represents a share of production costs that cannot be recouped by the market (e.g. land rental, fertiliser, etc.). The second tier takes into account a farm group's performance. It supports farms in specific areas of interest, such as organic farming, livestock, young farmers, etc. Direct payments are currently paid out at EUR 500 per hectare, which means the Quinta das Abelhas site is close to gaining its sum.

Guidelines: Income

Farmers can only receive direct payments if their gross income is EUR 30 000. However, they are still eligible to apply. CAPSS (Common Agricultural Policy Support Scheme) is available to farmers who have not received direct payments for the past two years and have a gross income below EUR 30 000.

A small or medium-sized farm can only receive CAPSS and direct payments. Direct payments will increase by up to 20% in 2014. This means that direct costs will increase for some farms in Portugal. The CAP will now also support organic farming, enabling farmers to claim subsidies for their production. The first payment will come into force on 1 January 2014, with a total budget of EUR 3.2 billion. These are great news and finding for the operations across the Alentejo region of organic farming.

It has been very successful in Portugal, where CAP got introduced. It has helped to increase agricultural production and create new jobs. There has been a significant change in the rural economy, with new businesses being established, such as milk product sales and tourism development. As a result, the CAP has also led to problems, including over-subscription of the market. As a result, products have lost quality. It is for this reason that organic farming is so critical. This will be an excellent opportunity for rural tourism to flourish in the Alentejo region, which has traditionally struggled with it. In addition to establishing organic farming throughout Alentejo and promoting it in the provinces and municipalities, it is possible to use it as a model for other areas of Portugal that need organic agriculture. The market offers a great opportunity, but we must be careful not to over-subscribe it as a critical lens focussed on monitoring and evaluation, which are reNature's core values.

5.5 Managing biodiversity and carbon sequestration long-term

Managing biodiversity and carbon sequestration long-term in Southern Portugal with regenerative agriculture is a viable case to aim at. Tree species are grown interspersed with crops in agroforestry systems, which can be considered a part of the agricultural system (Elevitch et al., 2018). According to several studies, agroforestry can contribute significantly to sustainable agriculture, especially for smallholders.

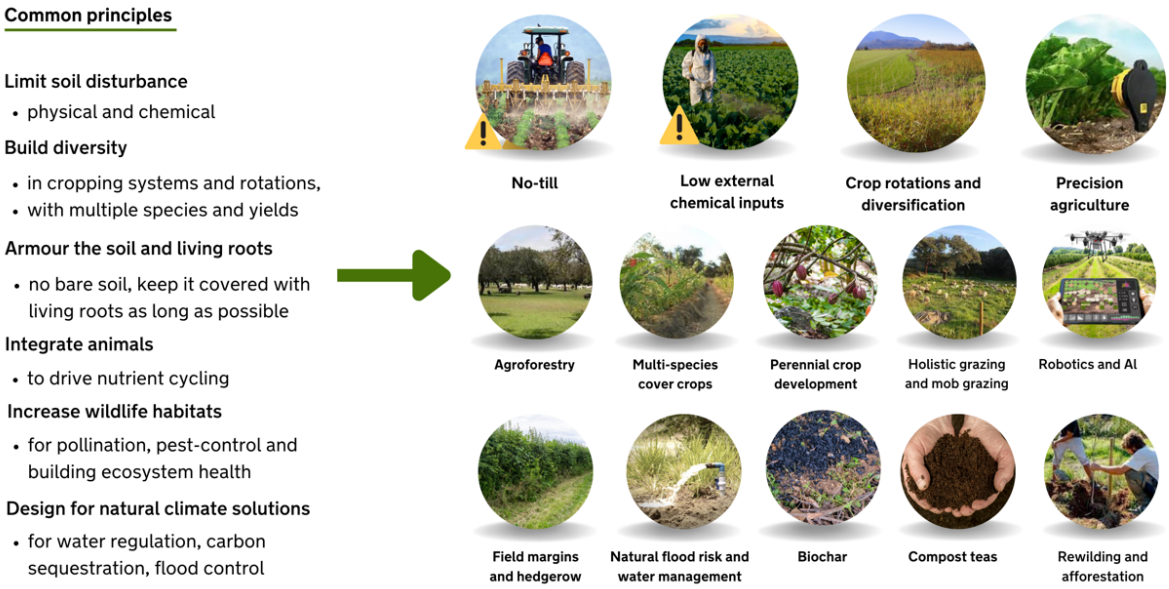

Fig. 18: *The Regenerative Agriculture Toolbox. A holistic overview of the possibilities for this practice.*

A significant amount of CO2 can be obtained through photosynthesis from the atmosphere during carbon sequestration in humid conditions. However, several factors, including climate, soil type, and management, affect how much carbon trees sequester, as illustrated in *fig. 25,* to serve as a demander early on.

Nevertheless, RA is field margins and uses multi-species onsite, multi-year experiments to assess impacts on soil organic matter, nutrient cycling, and ecosystem services. The project's four phases in Southern Portugal have been completed. Quinta das Abelhas are now moving into the fifth phase of scaling after first defining the area, designing the framework, opening to finance, and then implementing and current stage maintenance.

5.5.1 High Nature Value farmland (HNVf)

Throughout my research into ecological innovation and my exploration of critical natural capital, I understood the concept of high nature-value farmland. In the case of Southern Portugal, this is represented by the Mediterranean agroecosystems. In contrast to other areas of high nature value, rooms with low nature value have lower levels of biodiversity. Intensive farming systems characterise low Nature Value (LNV) farmland. Farming systems that sustain high biodiversity are considered high nature-value farmland. High nature value farmland describes extensive farming systems that use semi-natural land for conservation.

A global agricultural production increase of 1.5-2% is predicted by IFPRI crop models developed by FAO and the World Bank. An IFPRI model considers five factors to predict future crop production: yield potential, water availability, fertilisers, and technological advances. The model accurately predicted global agricultural production trends based on historical data from 1960 to 2005. Considering Portugal and regenerative agriculture's past and present reality, it uses as it can estimate a crop's potential yield.

5.6 Precision farming: Innovation, technology and adaptability

Precision farming is the future of agriculture as automation and robotics become mainstream. According to informant 12, precision farming improves the efficiency and profitability of modern agriculture by applying technological innovation (Farm21, 2022).

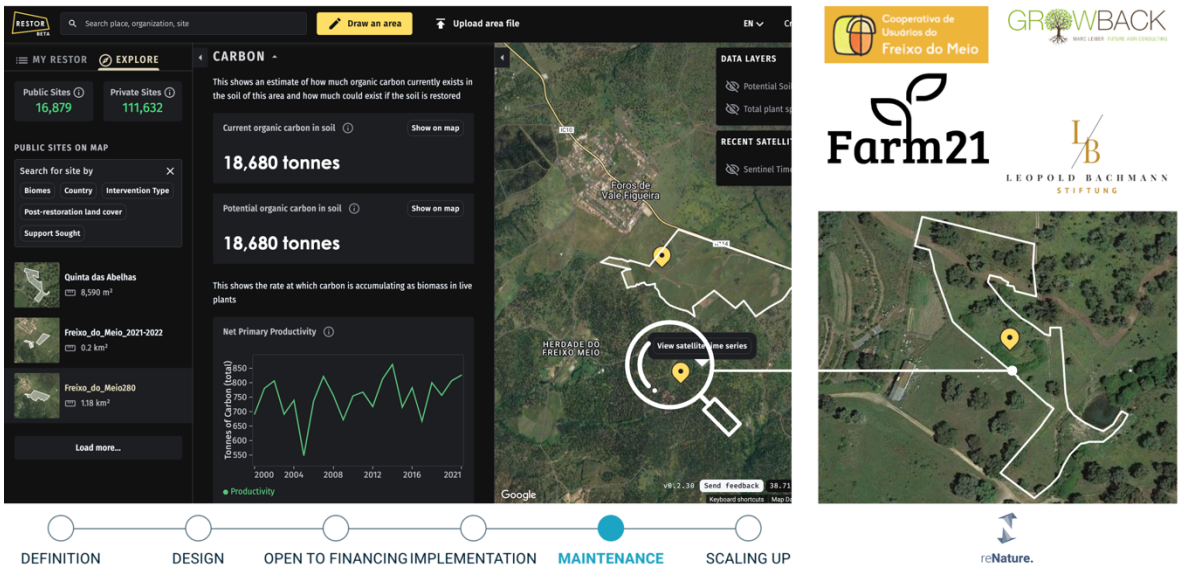

Fig. 19 *Status quo – Restor (beta) platform showcases GPS data, insights and diverse data layers for better on-site decision-making. | Herdade do Freixo do Meio, Portugal (2022).*

In the future, it is a great chance to transition from monoculture to regenerative agriculture by making farming as efficient and cost-effective as possible, but not at the cost of the soil or environment. Precision farming will monitor and analyse plant health, soil conditions, weather, pests, weeds, crop diseases, and soil conditions in actual time (Dagar & Tewari, 2018, p. 233). The methods are multi-skilled, using drones, mapping, and data platforms with on-ground sensors. Observed and experienced onsite in Quinta das Abelhas, Alentejo, this innovation is crucial to the future success of regenerative agriculture since it allows farmers to use information gleaned from the field rather than relying on instinct alone. Using robotics, drones, and big data in precision farming reduces environmental impact and produces more food at a lower cost.

A public timeline published by reNature (reNature, 2022c). The Quinta das Abelhas project is currently at status maintenance since sustainable transitions require changes in methodologies, tools, and measurements for documenting progress. Due to GrowBack's expertise (reNature, 2022a), they work closely with the land owners, Herdade do Freio do Meio. As part of the project, Baker Consultants provide regenerative land practice consultants to support the Leopold Bachmann Foundation in promoting a significant land upgrade. *Fig. 24* provides a detailed view of typical crops, carbon capture, and the site's area in m2 and hectare (reNature, 2022c). Based on Farm21's beta test status, among the various partners seen in fig. *24*, it should be reviewed twice at least before fully trusting to reflect proper conditions and, therefore, to set an urgency of action, e.g. supporting the UN's guiding principles and leading SDGs (United Nations, 2022a).

In agroecology, soil, water, plants, animals, people, and the environment are considered part of the complex interactions between soil, water, plants, animals, and the environment. As informant 13 told me (Dagar et al., 2020, pp. 187-188), this is handled by holistic planning, such as monitoring and evaluation. Further, Agroecology is the most sustainable form of agriculture because it creates a closed-loop system in which the carbon and nutrients are cycled back into the soil. Its basis is rooted in the study of ecological relationships between agricultural ecosystems, humans and the environment—a great blend of precision farming and regenerative agriculture (Farm21, 2021). You can create a more efficient and profitable farm with a more natural and sustainable approach to agriculture and actively monitoring and evaluating.

A robotised farming machine in action

Robotics and automation are changing the face of agriculture. They are already making a big difference for farmers, especially in precision farming, which uses technology to ensure that the crops receive the right amount of water, organic inputs, and other nutrients to produce the best quality possible. As informant 12 points out, intelligent technology, turning agricultural brands into AgriTech firms, gives feedback to crops and helps monitor brighter.

"..With such advanced technology, farmers can increase yields by as much as 40% while reducing fertiliser usage and fuel costs." (informant 12)

Monitoring and evaluation

A more sustainable and productive food system will be built with Mineral, Alphabet's moonshot factory. Insights into crops' growth are provided by combining soil and weather data with drone and satellite imagery (Yossi Matias, 2022). In preparation for the upcoming COP27, the influential global platform for politicians to discuss climate and environmental issues (UNCCC, 2022), the big tech giant, will be making considerable efforts. Restor's impact management platform goes beyond monoculture and net-zero land management practices to improve food security in 2022.

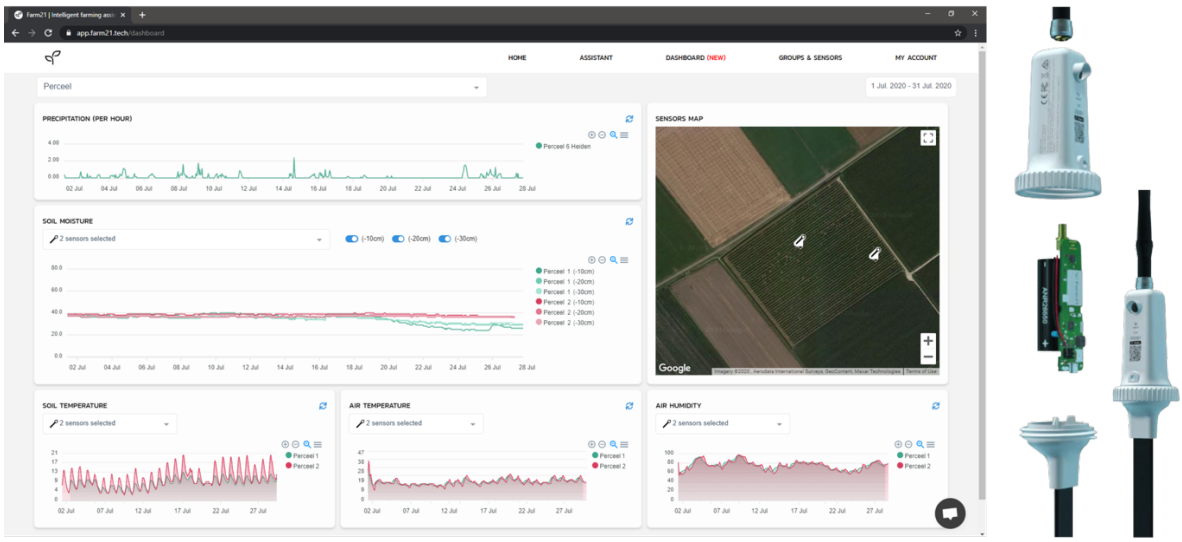

Fig. 20: *Measuring soil moisture, air and soil temp, soil moisture and how often the charts are being permitted—screenshot from Farm21 website (2022).*

Stakeholders can also use many data sets and points to make more thoughtful and assertive decisions. Consequently, due to the increased data sets and visuals, a cohesive and strategic

involvement across the agricultural value chain is necessary to optimise agricultural production flow. A project manager familiar with a few sights makes the mission easier to navigate. These two intelligent contributions to the debate over global strategic coordination and local responsiveness are illustrated in Figure 9 (Dicken, 2014, p. 129). In addition to the tactical aspects, they align with reNature's integrated management, monitoring, and evaluations for optimal results, strengthening ecological and social innovation. Last part is better livelihood by approximately better decision making and yields, hence reinvestments to infrastructure, management and scalation of Quinta das Abelhas.

Restor's technology has been used for many years by influential organisations, including the UN World Food Programme, the World Health Organization, the FAO, the Government of Canada and the European Union. Restor's "Food4Good" platform will improve access to food and reduce food waste by 2030. The company's platform combines AI, data science, blockchain and 3D printing technologies. Technology is already considerably impacting how we produce and consume food. Hence, GrowBack, reNature, and Herdade do Freixo do Meio have implemented that for Quinta das Abelhas, which means a better documentation (reNature, 2022a). Therefore, making the regenerative business case and scalability a viable one.

As the new era of automation and robotics begins, precision farming will be the future of agriculture. Precision farming improves the efficiency and profitability of modern agriculture by applying technological innovation.

For this part, we are going to analyse how the systems that GrowBack, reNature, and Herdade do Freixo do Meio are using to be able to provide their clients with more efficient processes to manage their land resources in Alentejo, Southern Portugal (reNature, 2022b).

As a first step, they use satellite imagery to detect land cover changes and then use (Geographic Information System) GIS techniques to make them easier to see and allow for more precise land management decisions. Despite using the same vendor's satellite images, GrowBack and reNature use different platforms. Additionally, these companies have improved their workflows with other technologies. GrowBack has used a GIS solution for over two decades to maintain a very efficient workflow at Herdade do Freixo do Meio, of which all client information is stored in a database, informant 14 told me discretely onsite. This is valuable to evaluate past, present and predict future outcomes from a given set of ha

land, and combined with Farm21 sensors and impact platform, this can be truly fruitful and sustainable outcomes to harvest for reNature clients and their respective partners.

5.7 Food sovereignty in Southern Portugal and farmers' livelihood assets

The southern part of Portugal is the most crucial area for producing fresh fruits and vegetables, especially tomatoes, cucumbers, potatoes and watermelon. It has been a leading exporter of these products since the mid-1980s, with around 60% of the total production exported to other European countries. Aside from supplying more than 50% of the fresh fruits and vegetables consumed in Europe, it also represents around 30% of the Portuguese agricultural sector. However, there are still many concerns regarding the quality of the produce, particularly with tomatoes.

«There have been immense heat waves across Alentejo and Quinta das Abelhas. Though you should be favoured more beneficial climate, this is the truth we tackle month in and month out.” (informant 14)

This product has been produced more frequently, but its quality has yet to be improved, which is the main problem. In this part, we will discuss the main issues regarding the control and reliability of food security in agricultural practices in the southern region of Portugal, specifically tomato production. That is why the CGIAR: research program on forests, trees, and agroforestry deliberately addresses national adaptation plans (UNCCC, 2020, p. 14). It is typical for the southern region of Portugal to face problems with food security related to agricultural practices, particularly regarding regulating pesticides, especially fumigants and fungicides. A reduction in pesticide consumption can also be expected if these volatile pieces are linked together through transparency in the agricultural supply chain.

Fig. 21: *Advanced view on the interlinkages of the AVC.*

Zoom in: Agri-food supply chain

Farmers' positions in the agri-food supply chain are governed by it at the top management level, as well as how to strengthen them. An EC task force was established in 2003 to support farmers' positions in the agricultural supply chain. As a result of the Portuguese market and the development of sustainable farming systems, the EC established the EFSA in 2003. It is responsible for assessing the safety of food additives and contaminants. The task force was established in 2004 by representatives from various food industry sectors.

There are several steps to zoom into here. First, R&D forms the bottom of the supply chain with proper incentives, and grants are most likely needed in the starting ground regarding long-term yield harvesting with no tilling or fertilisers. Input distribution and adoption take time, including the urgency of forming robust agri-dealer networks of sustainable farming practices, such as RA and AFS (*fig. 21*). Ethical labelling can create shortcuts for the consumers, but to get certified in the first place is a long hauling process. The five partners of reNature shape an innovative agriculture network onsite, with Farm21 sensors, the local knowledge of GrowBack and the land owner, plus Baker Consultants as experts. Then we need to establish the necessary conditions for the supply chains to be sustainable. This includes a well-trained workforce and a stable market. Third, they need the right technology, sometimes available or affordable. Fourth, they need to manage the production process and the market efficiently; fifth, they need to have proper governance and meet these conditions.

Zoom out: Market development

The European Food Safety Authority (EFSA) must work closely with other EU institutions to ensure that food and feed are safe. Additionally, the EFSA serves as an independent scientific authority supporting EU institutions. Zoom in: Food fraud Approximately a third of the food products sold in Europe are unsafe to eat, according to the European Commission's Directorate General for Health & Consumers. Many fraud cases have been detected in the retail and supply chain. This marks a need for organically grown crops, monitored by modern technology, which are safe for consumers.

Organic agriculture Organic farming is a way of production that emphasises using natural resources, respecting biodiversity and promoting sustainable development. The EU's Directorate-General for Health & Consumers has estimated that, in 2013, organic food and feed represented around 1% of the total market share. However, this figure is predicted to grow to 2% by 2020.

Value creation and innovative forces for land management

Companies have experienced significant changes in how they compete due to the current financial crisis. In addition to traditional market factors like cost, development, and price, companies must offer new products and services to retain customers. Business models, structures, and organisations must be changed to become more creative, collaborative, customer-centric and competitive. To do this, they must change their business models, systems, and organisations. Companies must deliver real customer value to create value for their customers to gain this new competitive advantage.

According to informant 12, Farm21 is developing an intelligent agricultural robot called the 'Agrobot' in collaboration with the University of Amsterdam (UoA). Absorbing this technological and knowledge upgrade, there will be intentional room for expansion. The robot will have a straightforward user interface that will make it easy for farmers to operate. Many small-scale farmers in the region could greatly benefit from the knowledge created, significantly if they could increase water availability and deal with extreme summer temperatures. As well as attracting young people to farming, developing expertise and utilising a defined AVC and toolset can make agriculture more economically viable through transparent documentation.

The feedback system in agroecosystems

As a reminder, agroforestry is a form of mixed farming where trees are grown on farms or in orchards. It is a system that combines trees, shrubs and herbs in a landscape, focusing on high-value tree crops, fruit trees and fruit bushes – utilised at Quinta das Abelhas and Herdade do Meixo do Freixos 600 ha land.

Agroecosystems are designed to be resilient to changing environmental and social pressures because of multiple factors at play and feedback. To function and remain resilient to climate change, agroecosystems depend on interactions between plants and soil microbial communities. The impact of these interactions on agroecosystems still needs to be determined. Food demand is increasing as population and income rise. To improve livelihoods and foster food security and resilience, regenerative agriculture is intentionally integrated into sustainable food and agriculture.

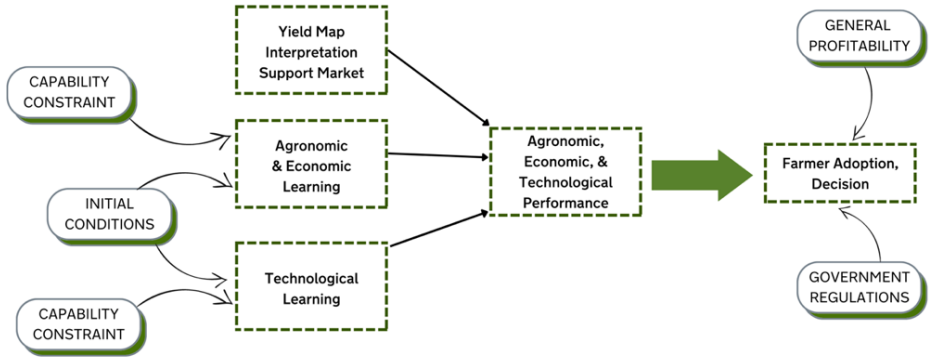

Fig. 22: *Exogenous and endogenous factors influence yield monitoring and mapping adoption and diffusion.(Fisher et al., 2000, p. 288).*

Identifying the elements of regenerative agroecosystems is crucial to support the market and economic traits. In agroforestry, technical learning involves using natural tools and techniques for monitoring while building critical natural capital. Identifying the constraints limiting product, service, and technology development and the factors that enable the company to adapt to new challenges and opportunities. So, farmers need thoughtful training and upskilling to handle new technology and impact dashboards to document the operation's findings. The capabilities constrained by markets and economic development are most relevant for the regeneration of agroforestry systems.

Different indicators assess land management decisions. The European Agricultural Guidance Strategy (EAGS) has been used to evaluate land management changes in Europe and elsewhere. EU is not only an international community of nations but also works together to improve soil organic matter (SOM) quality of life for its citizens. Hence, incremental upskilling step by step is helpful for a better adoption rate.

5.8 From regional environmental planning to implementation

As a result of the EU Common Agricultural Policy (CAP) reform, the European Commission (EC) has created a particular budget line for this purpose. The CAP reform is the most extensive EU structural reform since the Treaty of Rome in 1957. It is aimed at simplifying and streamlining the CAP. To achieve these goals, the EC has introduced a new payment system for farmers. Instead of direct subsidies, farmers will receive payments for the production of specific products according to the quantity of land they own or lease.

This new payment system is called the *land-based compensation system*. The EU Parliament has already adopted a resolution on this issue. According to the solution, the EC should introduce a policy enabling agricultural innovations in developing countries while allowing farmers to benefit. This could be achieved by setting up a particular budget line for agriculture, allowing Member States to support agricultural innovation in third countries. In addition, farmers in developing countries could benefit from the EU's knowledge spillovers through bilateral cooperation agreements. The EC has already started this process.

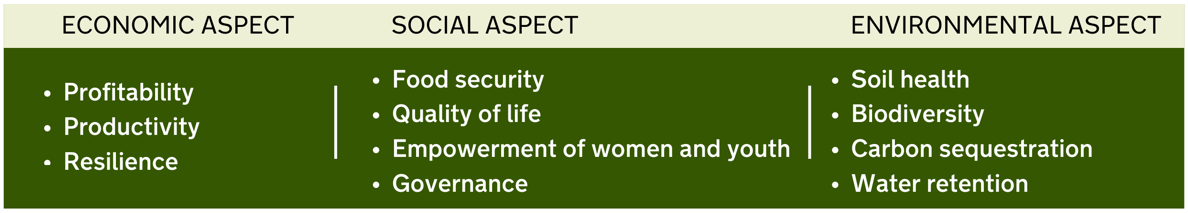

Fig. 23: *Economic, social and environmental aspects of RA and AFS.*

The economic aspect covers productivity, but often we sacrifice the soil health and biodiversity levels for quick profits. Therefore the social part of the quality of life and proper social aspect of the quality of life, adequate food security, *and* food sovereignty are needed for all stakeholders to gain a voice *(fig. 23*).

Furthermore, conventional farming is one of the biggest problems in agriculture today because crops are harvested individually and simultaneously. By doing so, we are deprived of the chance to harvest crops at different times of the year. This problem could be solved by diversifying harvest methods and times while also increasing incomes and competitiveness for those who practice regenerative agriculture. It would allow us to maximise agricultural production while saving water and energy at alarming rates during heatwaves and summer.

«The main difference of what we do at reNature and the other conduct is that we are mimicking nature and build back better, instead of putting toxic means to the soil." (informant 1)

It has been my experience and the international news debate that intense drought and wildfire destroy infrastructure and affect many people's lives. As the IPCC reports reveal, the problem of moving to 2C degrees higher will only be exacerbated by how we are using the land and the methods used, coupled with a brutal wake-up call for food sovereignty and production (IPCC, 2022, p. 15). Another important problem is the use of pesticides. Recent years have seen a significant increase in pesticide use. Because many farmers use pesticides to grow their crops, it continues to spiral in negative terms, intensifying pesticide returns in destroyed topsoil and soil quality to grow foods, as informant one explains with significant worries given the current global food crisis. In addition to not tilling or using pesticides, RA uses cover crops to absorb water and conduct the surface better.

Agricultural policies must balance environmental protection and social justice in the developed world. There are too many stores in the developed world and too many consumers wasting too much food. To determine the future of agriculture, it is essential to consider the economy, the environment, and the social dimension. The land at Herdade do Freixo does Meixo in Alentejo offers tremendous potential, but we should continue growing the crops we already know. Despite this, the soil is also insufficient to produce enough food, so the need to preserve water resources must be balanced with these two elements.

If we continue to do business as usual, our problem of not having enough arable land to produce enough food to feed the world's population will only worsen. This practice, however, has many adverse effects. The thesis proves that the use of pesticides directly impacts the environment. It causes numerous problems in the soil and water. Pesticides cause many

deaths in insects, birds, reptiles, fish, and amphibians. Pesticides also kill crops we need to eat. We need many legislative acts, regulations, and guidelines in the current reality. The soil, plants, and animals must have enough resources under sustainable agriculture. To achieve a more natural agriculture system, pesticides and fertilisers must be reduced.

Food production needs to be improved to adapt to climate change and a growing population. For long-term seasoning, organic fertilisers are optional as they can damage soil quality and topsoil but can reduce the amount of fertiliser required while maintaining the necessary nutrients and reducing water usage simultaneously. With the help of energy, fertilisers, and water, modern agriculture can produce high-quality food with less energy and water. They used less energy, fertiliser, and water to achieve sustainable agriculture, sacrificing biodiversity, soil quality, clean air, and climate change. Regenerative agriculture and agroforestry should also be used to minimise environmental impacts while producing good-quality food.

5.9 Increased biodiversity through agile governance and regulations

The United Nations adopted a Global Plan for Action for Biodiversity (GPA) in 2011 to prevent irreversible biodiversity loss. In agile governance, biodiversity conservation and sustainable use goals must be set and managed adaptively. An approach to decision-making based on a dynamic worldview was developed to respond to changing circumstances. Using scientific knowledge, experience, and the involvement of stakeholders, we can gain a deeper understanding of nature, which is complex and difficult to predict. This text examines agile governance from a top-down perspective as part of the United Nations biodiversity programme. Leadership and communication are synced with integrated management.

One of the pillars of the UN's Biodiversity Strategy for 2030 is the GPA, which seeks to achieve the highest degree of biological diversity protection and sustainable use by 2030. CBD's report Global Biodiversity Outlook 5, illustrates the need to halt biodiversity loss by 2030 and develop a new conservation agenda alongside this strategic framework (CBD, 2020). Many countries and regional blocs have conducted thoughtful incentives to conserve biodiversity and make it more sustainable. Through agri-environment schemes (fig. 20), farmers can receive payment for agricultural techniques that promote biodiversity in farmed landscapes. According to the national party reports, Portugal, an OECD country, should reduce renewable energy taxes and encourage service ecosystem payments and offsets

(European Parliament, 2021). Certification and compensation schemes should be established to promote ecotourism, landscape conservation, and technology adoption.

Due to increasing responsibility for biodiversity across European member states, the EU has become increasingly concerned about its activities' environmental impact. The European Commission (EC) Environment Policy DG organised the first-ever Biodiversity Summit on 6 November 2010 with its members to discuss this growing issue. To address the challenges posed by biodiversity loss, the summit aimed to strengthen the EU's response.

5.10 Environmental, social and governance investment

The concept of ESG investment is a new concept developed by the UN Global Compact. The idea behind it is to address sustainability concerns in companies by focusing on the three pillars of sustainability (people, planet and profit). This can be done in different ways: ESG investment can be made in the form of ESG funds, which are designed to invest in companies with good environmental, social and governance practices. ESG funds aim to provide investors with a stable return through long-term investments based on the triple bottom line.

The companies that are invested should also be transparent about their activities and should be able to demonstrate to the public that they have implemented good practices. The global compact The UN Global Compact (UNGC) is an initiative that was launched in 2000 to create a business environment where all businesses can operate sustainably, and it is a voluntary commitment by companies to follow certain principles. The principles cover people, Environment, Social Responsibility and Governance. These principles address sustainability issues that companies may face, such as labour conditions or pollution.

5.10.1 Criteria and scores of ESG

An event or trend can be measured by calculating its standard deviation from the mean. It is common practice to calculate standard deviations by dividing the norm by the square root of the number of words separated by the number of observations. ESG scorecards are available in various formats, including industry-specific and industry-agnostic.

In scoring systems, material issues are assessed. An industry-agnostic score incorporates widely accepted factors important across many industries. Among these are the same problems influencing environmental, social and governance (ESG) scores, but some are

unique to particular industries. An organisation's performance against each standard is also assessed by ESG ratings, which determine a weighting for each measure. Organisations' ESG scores are usually the sum of their (proprietary) criteria ratings and weightings.

Moreover, ESG ratings are generated using rating platforms. Analysts evaluate corporate disclosures, conduct management interviews, and review publicly available information about an organisation to assess its performance objectively. Stakeholders like investors and employees have different perspectives on rating systems, and rating platforms have evolved to accommodate this diversity.

5.10.2 ESG: Guidance and reporting frameworks as risk assessments

In recent years, ESG has become a growing concept with momentum. Companies must report on their ESG performance and the impact of their investments related to ESG. These issues have become critical in recent years because of climate change, water scarcity, and biodiversity loss (Commission, 2022b). Drought or flooding threatens food security and livelihoods. A company's ESG performance describes its ability to cope with macroeconomic changes and social and governance performance (Hill, 2020). These include human rights, the environment, and equitable distribution of benefits and burdens.

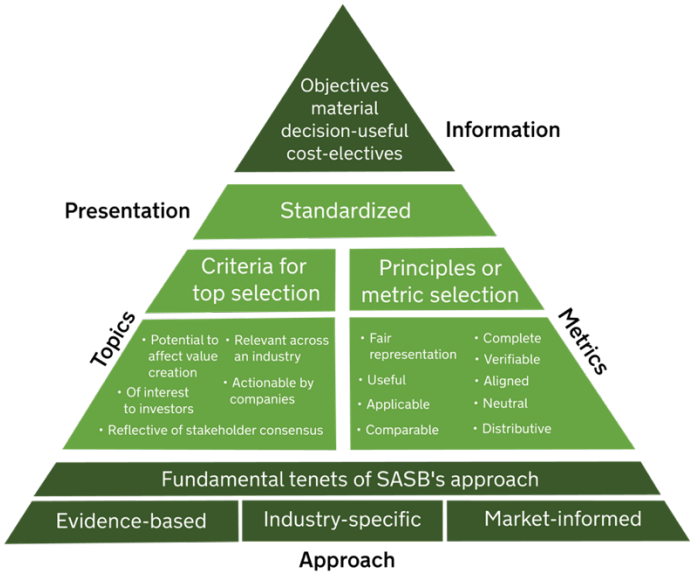

Fig. 24: SASB framework.

SASB sees regenerative agriculture as an adaptive, complex system that consists of many components (fig. 24). These components interact in an ecosystem. Ecosystems are affected by external factors, such as climate, soil quality, and resources, and those factors are

influenced by other environmental factors. Components can interact positively, negatively, or neutrally. Therefore, the framework enables the development of robust guidance frameworks for the Alentejo region by understanding the complex interactions between its components. As a result, reNature can identify and utilise its knowledge and technology to gain market shares and mainstream regenerative agriculture, thereby strengthening its absorptive capacity. Multiple components are involved in regenerative agriculture, a complex adaptive system (SASB). The interaction between these components impacts the entire system, and these interactions are influenced by external factors, including climate, soil quality, and resources. Additionally, members can interact negatively, positively, or neutrally. The framework can also be used to analyse a system on its three levels: the individual, the group, and the community. Regenerative agriculture is a complex adaptive system (SASB) with multiple components. Several factors influence the interactions between these components, such as climate, soil quality, and resources.

Individual level

The SASB framework suggests that an agricultural system is influenced by various factors, including climate, soil quality, resources, and land use. This means a farm is affected by different factors, including its location, soil, climate, management practices, resources, and interactions. The SASB framework identifies five categories of individual components that interact with one another to influence the farm's success: the farmer, the farm operation, the market, the production system, and the environment (Vizinho et al., 2021). Farmer Farmers are the primary producers in an agricultural system. They own and operate the farm, manage its inputs, and are responsible for its outputs.

Production level: SASB

The SASB framework includes farm operations as part of the production system, but the level of analysis suggested by the SASB framework is at the farm level. At this level, we can differentiate among the activities that make up the farm operation (Chaudhuri et al., 2021). For example, we can look at the farm's overall operations, such as the crop growing season. We can also look at production processes, such as harvesting and processing.

Two levels make up the SASB framework. A farm can be differentiated into several different types of farm activities (e.g., cropping, livestock production, forestry), and a production process can be identified as a specific activity within each type of farm activity (e.g.,

planting, weeding, harvest). To adapt to the Alentejo-based farm, SASB provides comprehensive guidelines for developing an integrated farm management system.

To achieve an adaptation rate, guidelines must be implemented. The procedures must be adapted in parallel with farm management practices. Farm management practices: SASB The guidelines provided by the SASB framework is developed from the farmers' viewpoint and needs (Correia, 1993). However, the procedures must be adapted to the farmer's situation to be fully implemented. The rate at which the policies are adjusted depends on the farmer's ability to implement them effectively. In this context, we can differentiate between the farmer's and Quinta das Abelhas' adaptation.

National policy plans: Portugal

Local, regional and national governments, farmers and rural areas must all be involved in the hybrid approach to upgrade the AVC comprehensively (Dicken, 2014). This should be practised even more profoundly since they are all critical stakeholders. Agriculture and forestry sectors should maintain their traditional rural identity while contributing to food security and economic development.

The National Programme for Agricultural Development (NPDA) will be responsible for implementing the ESAS. Further, the national strategy of Portugal puts agriculture at the heart of economic development and aims to raise the competitiveness of agricultural products in international markets (Soukiazis & Antunes, 2011). NPDA's main activities are linked with the understanding of implementing NPDA's strategic objectives to contribute to sustainable rural development and food security. Plus, supporting the development of agro-food industries based on the principles of respect for the environment, social justice and human rights (Desjeux et al., 2015, p. 3). Again, this is a natural bridge to the ESG of interest. Furthermore, by developing and implementing policies and projects designed to improve the quality of life of rural people, incredible results can be achieved for regenerative agriculture regards economic-political driven motives to scale-up regenerative agriculture across Portugal.

The stakeholders' role in ESG score

Anyone interested in the company or the project is considered a stakeholder. In addition to financial interests in the company, stakeholder interests usually include environmental, social, and legal claims (European Commission, 2022c). In addition to concern about the

company's success, stakeholders may also be concerned about the company's future, financial health, or impact on society. Stakeholders have different motivations, so how they are involved in the company's success is often unpredictable.

Among the many ways stakeholders use ESG scores is by investing in a company or selling a stock, for example. In addition, companies can use ESG scores to identify potential customers, investors, and suppliers. Thirdly, companies can use ESG scores to justify their green behaviour and buy environmentally friendly products.

5.10.3 EU Soil Strategy 2030 – Key policies

Regarding time and space to go deeper, I have selected five out of fourteen interlinked frameworks under EUs Soil Strategy 2030. These include EUs Biodiversity Strategy for 2030, Farm to Fork Strategy, Common Agricultural Policy (CAP), Green Financing & Taxonomy and EU Forest strategy directly linked to the previously discussed AFS.

The first three are the most important, while the last two are the ones that could be more easily transposed into EU policy and management. The EUs Biodiversity Strategy for 2030 is an action plan to restore biodiversity, which is essential for the sustainability of ecosystems, landscapes, and regions.

Among the cornerstones of the EU's Soil Strategy is the Biodiversity Strategy for 2030. The EU's Biodiversity Action Plan is a set of two primary documents in its current version. The first is a 2011 document (EC, 2022), an extension of the 2010 Biodiversity Strategy for Europe. In 2014, the Biodiversity Implementation Plan (BIP) was published and updated in 2016 (EC, 2019). The eight chapters in the report address various aspects of biodiversity, including plants, animals, habitats, species conservation, and ecosystem services. A high level of biodiversity will be achieved by 2030 as part of BIP, which also aims to improve agricultural and environmental impact for future generations. This is why it includes several measures, such as reducing the overall environmental footprint, improving the use of natural resources and reducing emissions.

As part of the EU's Soil Strategy, this strategy is intended to support soil health and ecosystem services. Furthermore, the EU's Climate and Energy Strategy is a plan to combat climate change, including land degradation. Common but differentiated responsibility

(CBDR) is the basis for the EU's rural development policy. It is one of the pillars of the EU's rural development policy. Each member state is responsible for implementing and enforcing the EUs CAP in its territory. The EUs Rural Development Policy is a critical element of the EUs agri-food policy, which includes two main strands: rural development and agricultural and fisheries policies.

Farm-to-Fork Strategy

Three EU institutions shaped this ambitious Farm 2 Fork Strategy. These include the European Commission, the European Parliament, and the Council of the European Union (EFSA). By implementing concrete actions, the organisation hopes to reduce adverse environmental and health impacts while promoting the competitiveness of European farmers to achieve a sustainable and environmentally sound agriculture sector (EASAC, 2022, p. 14). The strategy addresses three main areas: reducing adverse environmental effects associated with agriculture, increasing organic farming methods, and reducing emissions.

Fig. 25: Farm to Fork Strategy

The EU (European Union) will become carbon-neutral by 2050 using the F2F strategy, launched on 20 May 2020 as part of the European Green Deal. We must balance what we eat with our planet's capacity to produce and consume sustainably and fairly. Providing adequate, nutritious and sustainable food can reduce food consumption's environmental and climate impact and the process behind it (Commission, 2022c). The F2F strategy (*fig. 25)* covers ten years. Also, taking into account maintaining food affordability and creating a fair return for all concerned. In addition to ensuring health and food security, it also provides food security.

The holistic approach of the EU Farm to Fork strategy increases the likelihood of transition to sustainable food systems, including avoidance of ploughing the soil (EASAC, 2022). The most present and vital technique of monoculture-based farming. Also one of the significant sources of soil degradation. However, this type of farming is highly resource-intensive and requires high investment in machinery, fertilisers, chemicals, seeds, and irrigation. In addition, it could be more productive, especially considering that much of the input is used on the land rather than for food production.

Most of the information used on the farm is used to maintain the soil rather than produce food. Therefore, EU F2F, conceptualised by the European Union (EU), aims to cover every stage of the food chain, from production to processing and distribution to consumption. In practical terms, the strategy has a positive meaning for the agricultural value chain for the environment and consumers. It is aimed to ensure that food is produced and distributed in an environmentally friendly way and to make it available to all EU citizens. To ensure food production and consumption are sustainable and conserve nature, biodiversity, and ecosystems, a sustainable food system consists of several policies and actions (BASE, 2022). As a much-needed benefit, it also provides decent work and income opportunities for farmers and other actors along the entire food chain in the EU Farm to Fork strategy context.

Promoting sustainable food production

The strategy seeks to ensure sustainable food production. It also aims to provide a balanced European diet and promote healthy foods, especially fruit, vegetables, and fish. Shortly, it is enhancing the competitiveness of EU agricultural producers. The strategy also supports small and medium-sized enterprises (SMEs) in agriculture.

Furthermore, the strategy aims to help farmers and other agricultural stakeholders to adapt to climate change and the associated effects of extreme weather events. The system also seeks to improve the quality of life for farmers and rural people. The first step in the process was taken in 2014 when the European Commission adopted the Agricultural Greenhouse Gas Emissions Targets Regulation, which set binding targets for greenhouse gas emissions from agriculture in 2015 and beyond. In this context, the Commission adopted a communication on the EU's agricultural GHG emissions targets for 2020.

In the national context of Portugal, a sustainable, agricultural food value chain can be achieved by implementing EU Farm to Fork, launched by the EU Commission in May 2020. Using protected areas, nutritious, safe, and high-quality food can be grown and harvested. The EU Farm to Fork and Biodiversity Strategy was released on the same day (Commission, 2022d). They are both parts of the Green Deal, which aims to improve food sustainability at every stage. Biodiversity and agriculture complement one another, so this is of particular importance.

EU Green Deal

By 2030, the EU Green Deal aims to reduce greenhouse gas emissions by 40% (Commission, 2020a). Changing lifestyles and production methods can help answer some questions about climate change. Whether Brexit will affect the EU F2F strategy remains to be seen. However, we are here to discuss Portugal. Portuguese farmers in Alentejo and surrounding regions will implement it over the following years. The Green Deal for Portugal focuses on three areas to ensure a sustainable and climate-friendly economy for the EU (Commission, 2020b). Regenerative agriculture significantly impacts the environment, and sustainable farming practices are essential for increasing efficiency. Sustainable farming practices integrate inputs and orientations using renewable energy sources, soil management, and crop rotation.

A second focus area of the EU Green Deal is agriculture's role in addressing climate change, particularly in reducing livestock emissions. A part of the solution to reduce greenhouse gas emissions from agriculture is livestock, which emits 14% of all greenhouse gas emissions. The Member States will fund the Green Deal following a new distribution formula, which means that the EU will contribute 50% of the total costs, and the Member States will donate 50% of the total costs (Union, 2022, p. 24). The Portuguese Government will not incur any additional costs as a result.

EU Taxonomy on Sustainable Finance and regenerative agriculture

As part of the EC's communication, representatives of various member states, industry associations, academia, and NGOs discuss the work of the Task Force on Sustainable Finance (TFSF). As a guiding principle for future research and policy, the task force recommended that the EU develop a definition of regenerative agriculture.

The TFSF then drafted a recommendation on the topic. This document is now being finalised and will be published shortly. The EC has decided to support the publication of the TFSF's proposal by including it in the EU Taxonomy (EU Technical Group on Sustainable Finance, 2020). EU Taxonomy on Sustainable Finance The EC communication is based on the work of the Task Force on Sustainable Finance (TFSF), which was established by the EC in April 2013 and includes representatives from various member states, industry associations, academia, and NGOs.

EU Forest Strategy

It is crucial to simultaneously implement the EU Forest strategy in the Alentejo region as it is implemented throughout Europe due to its implications for the area. There must be a regional forest management plan for the Alentejo region. In planning and executing the EU Forest strategy, the principles of the system are actively applied while taking into account local conditions and context (Desjeux et al., 2015). Therefore, forests will be managed better and cost-effectively, resulting in a better and more sustainable future. Alentejo forest policy aims to protect forests, their ecological functions and services, and improve residents' quality of life in forest-rich areas.

A 25% reduction in wood consumption in EU forests by 2030 is the main objective of the new strategy. As compared with previous systems, this new target represents a significant change. Previously, forests were to be covered by 5% and wood produced by 1%. The new goal is much more ambitious.

After experiencing intensive droughts and wildfires on site in Portugal and following international news, many people's livelihoods are affected. The IPCC reports reveal that today's reality will only exacerbate the problem of moving to 2C higher overall. It boils down to how we use land and methods. The study shows that pesticide use has increased significantly over the past few years, another critical problem (IPCC, 2022). Consequently, pesticide returns in destroyed topsoil and soil quality to grow food continue to spiral negatively because farmers use pesticides to grow their crops. In addition to not tilling and pesticides, RA uses cover crops to absorb water and conduct surface better.

5.10.4 Rearchitecting for a substantial upgrade for food sovereignty

First, food sovereignty means producing food locally and on a small scale without being dependent on external sources and controlling consumption and distribution. To achieve this, it is essential to acknowledge that regenerative agriculture comes in many forms, some of which are more efficient than others. Let us discuss how to apply regenerative agriculture principles to our food system.

The most crucial principle of regenerative agriculture is that it should be integrated into our society, not separated from it. This means that we must change how we live, not just farm. We must stop producing food for consumption and have food for nutrition and health.

Further, we should profoundly consider a different kind of agriculture that works harmoniously with nature (Bodie & Jones, 2012). This applies to the global framing objective of the EU Sustainable Finance Taxonomy, which is to ensure that all worlds' ecosystems are restored and adequately protected. At this moment, naturally occurring species apply, and soil organic matter is protected and enhanced, achieving land degradation naturally.

Agricultural land use is a significant component of the European Union's Common Agricultural Policy. The CAP supports farmers through direct payments for production and other support schemes, regarding its focus on local and regional development (Anderson et al., 2019). The EAFRD provides funding to local authorities for infrastructure projects in rural areas. The CAP for Landscape and the Rural Environment is a separate policy that supports landscape-related activities. It was created by the European Parliament and the Council in 2010, replacing the previous CFP-Rural Development (CFPRD) policy.

5.10.5 Structural components and their influence on the agricultural value chain

In agriculture, structural components are the essential elements of production units that directly affect the agricultural value chain (Devaux et al., 2018). These include buildings, machinery, equipment, land, natural resources and capital assets (e.g. irrigation systems, storage facilities, etc.). In agricultural value chains, physical input is an essential element. It should be organic when producing goods or services for viable and sustainable outcomes with minimised GHG adverse effects.

Only through physical input or foundational work on the soil can a value chain be realised. Structural components in the agricultural value chain have critical characteristics, such as nature and structure. Their nature determines whether they are used for growing crops or livestock. Structure describes the structural elements of the agricultural value chain. For example, a field can be used to grow crops or to graze livestock. Agricultural value chains can be described as follows: the nature of the area is determined by the use it is intended for. Farms, the land they cultivate, the crop they grow, the tools they use, and the machinery used to harvest, process, and transport the goods they produce make up the main structural components of the agricultural value chain. End users of the agricultural value chain are farmers. They use the agricultural value chain to produce the necessary goods, crops and services.

5.10.6 Knowledge development and model farming

A regenerative agriculture model has been developed by reNature in collaboration with farmers, agronomists, and other stakeholders. Farmers can transition to more sustainable agriculture with the model by integrating natural processes into crop production. In addition to using perennial forages to increase soil organic matter, cover crops to control weeds, and diverse cropping systems that take advantage of the symbiotic relationship between plants and microbes, these techniques can be used (Dagar & Tewari, 2018, p. 271). This model emphasises knowledge development and dissemination.

Fig. 26: *Left: Model farming in practice with an active workshop at Quinta das Abelhas, Alentejo, Portugal, for upskilling. Right: An informative social media post by reNature.*

Farmers can use a learning tool developed by reNature to develop regenerative agriculture systems. An assessment of the environmental impacts of different farming systems can be conducted using a workshop-based model that emphasises a set of theories and practical examples (reNature, 2022c). Data from several other case studies have been used to develop this model, validated against data from multiple sources. Further, reNature facilitates sharing information among all involved parties, decision-makers, and regulators by collaborating directly with farmers. Additionally, reNature has developed an online platform for farmers to share their experiences and learnings and access their data and reports (Restor, 2022). As an outcome, reNature helps possible return on investment for the stakeholders involved by creating possibilities to reap long-term income sources from RA if only patience and

intelligent work are implemented. Meaning sustainable change requires knowledge, patience, and commitment.

Research

reNature has conducted many research projects on various topics related to regenerative agriculture. One such project investigated how different nitrogen fertilisation methods impact the carbon dynamics within a soil profile (Baumann et al., 2022). Another study investigated the effect of cover crops on improving soil quality by looking at how cover crops affect the amount of organic matter, microbial diversity, nutrient cycling, and other soil health indicators. As a result of eco-innovations, environmental impacts are reduced, resilience is increased, or natural resources are used more efficiently and responsibly to achieve sustainable development (Devaux et al., 2018). Developing a solid community and understanding fundamental financial mechanisms with relevant stakeholders can favour endangered soils and nature. Additionally, these circumstances can transform livelihoods on the ground, upgrading the Alentejo region and strengthening links with sub-urban areas.

5.10.7 Carbon sequestration and biodiversity

Regenerative agriculture is simplified in the following pictures, as with most photos trying to capture soil's complexity, but they provide an excellent example of soil regeneration over time. A regenerating boreal forest develops a litter and humus layer on sandy soil after agriculture clearance, as shown in the top picture. Below are the stages of secondary succession. However, this is only a simplification, and soil regeneration can take less or more time based on the context, agricultural practices, etc. Although this practice has been in use for decades, social media and the internet have helped to raise awareness (Slota, 2022). In addition, it helps people better understand what soil structure means to soil health and regeneration by illustrating it.

Fig. 27: *Development of fungi-rich soil.* (Slota, 2022)

A strong relationship exists between carbon sequestration and biodiversity. Biodiversity plays an essential role in carbon sequestration as one of the most powerful solutions to climate change. As we discussed previously, pollution, deforestation, and other environmental problems result in losing a large portion of our natural ecosystem each year (Dagar & Tewari,

2018, p. 699). The process of sequestering carbon requires taking biodiversity into account. If we view climate change from a carbon perspective, biodiversity loss is a fundamental cause. However, many methods exist for conserving biodiversity, including carbon sequestration. During a carbon sequestration process, carbon dioxide is captured by plants, animals, or microorganisms within an ecosystem (Ferrara et al., 2022, p. 15). Climate change is caused by carbon dioxide, a greenhouse gas. We can keep carbon dioxide out of the atmosphere if we capture it. One of the reasons climate change is occurring on earth is the release of carbon dioxide from fossil fuels.

Cultivation

In regenerative agriculture, various cultivation methods are used, including no-till, minimum-tillage, no-dig, mulching, intercropping, cover crops, green manures, compost applications, compost tea applications, and others. The purpose of some of these techniques is to improve soil health, while others are to control weeds, manage pests, or sequestrate carbon.

Occasionally, grazing can reduce erosion, promote nutrient cycling, and improve soil quality by creating a more diverse ecosystem. These techniques are also applied to help make the conditions for more varied ecosystems. Animals are used for grazing on the land, in this case (Dmuchowski et al., 2022). In addition to keeping the grassy layer above the soil surface, grazing animals can also help maintain the soil's organic matter content. The use of grazing methods like silvopastoral farming and agroforestry, as well as regenerative agriculture, reduces erosion risk.

Manure from livestock can be used as a natural fertiliser in some cases. It is also used to control weeds by grazing and livestock. In some cases, livestock is raised for human consumption or meat. In addition to reducing the number of weed seeds, livestock can also tramp the soil to control weeds (Dagar & Tewari, 2018, p. 336). As part of regenerative agriculture, cover crops are applied to the ground above an existing crop. Therefore, forcing someone to be dedicated to 100% plant-based diets is not viable, as combining is natural.

Also, regenerative agriculture boosts natural diets and nutrient levels using compost, manure and other soil amendments. As with all agriculture, regenerative agriculture requires inputs. These include a variety of seeds, fertilisers and herbicides. The most important information is the land, which is often a problem in the developing world. Land costs can be prohibitive to

farmers who need them for other purposes. If this is the case, regenerative agriculture can be used to increase the productivity of existing land. This is done through the use of cover crops, which are used to protect soil from erosion.

The exploration and knowledge absorption in the Alentejo region has gained my trust in regenerative agriculture, and I have seen the results onsite. Since the exploration site at Quinta das Abelhas has been a success so far, as per status is in the monitoring stage before eventually being fully scaled, the results shared here can help others implement these practices in their areas. The Quinta das Abelhas project is one of many agricultural projects aiming to improve the world's food security by increasing the production of fruits and vegetables through innovative methods (reNature, 2022c). As such, many lessons from this project can be used to enhance other similar agricultural ventures. As far as long-term benefits and how to implement cover crops are concerned, much remains to be learned and implemented.

5.10.8 Alentejo's farming networks and their importance

Land use planning in rural areas is increasingly recognised as an essential component of economic development. The European Union (EU) recently identified a regional agricultural development strategy in light of the Lisbon Strategy. In this paper, I provide insights into how networks have evolved and how they can be used to support the implementation of these strategies (European Union, 2020). It also analyses the importance of networks in the development of agriculture in Alentejo. Analysing the structure and importance of networks in the region served as the basis for the research.

As a result of my empirical collection with informants 3, 7 and 12, it is evident that networks have changed over time. In the first period, they were primarily used for information and resources. In the second period, networks provided a framework for coordination and communication; in the third period, they supported the development of projects. Networks are still crucial in the Alentejo region, but their role has changed. Each of the three periods involved different roles for informants 2 and 4. Informant 2 was one of the first informants involved in the project and took part in the network's meetings. While the first period focused on using the project's resources, the second and third periods concentrated on coordination and communication to strengthen RA as a legitimate practice in agriculture.

Sustainable agriculture, specifically regenerative agriculture in syntropic conditions, aims to increase soil productivity and climate change adaptation while tackling intensive weather conditions such as drought (Dagar & Tewari, 2018, p. 270). To achieve these aims, knowledge must be shared and exchanged. Networks play a crucial role in achieving this. As long as regenerative agriculture is adequately maintained, monitored, and evaluated as a basis for success, it can sustain healthy ecosystem growth and local economies in Alentejo and Portugal. As well as being the largest employer in many countries, agriculture is a crucial part of economic growth.

5.10.9 Multi-level stakeholder engagement in regenerative agriculture

Stakeholder engagement at multiple levels was becoming increasingly understood and applied in Europe and worldwide. In addition to increasing public and private investment, the system improves product development and promotes agricultural practices that are economically profitable, environmentally friendly, and socially acceptable.

The stakeholder plays a crucial role in multi-level stakeholder engagement. The four main stakeholders in agribusiness are the consumer, the farmer, the government, and the investor. Managing engagement requires stakeholders to be involved in decision-making and the ability to influence outcomes. Consumers must buy products to engage in agricultural value chains. To engage the consumer, the first and most important stakeholder, it is necessary to start the engagement process at the consumer's level (Alfarra et al., 2018, p. 40). Farmers produce the primary product of agricultural value chains, which are developed and implemented through multi-level stakeholder engagement. The goal of engaging stakeholders at multiple levels is to involve as many stakeholders as possible in decision-making. Understanding how these stakeholders relate is essential to engage them effectively in the engagement process.

5.10.10 Pressure from society and market formation

The ecosystem is in crisis due to the loss of many native species and the lack of conditions for them to establish themselves in silvopastoral systems combining cork and holm oak with pasture. Meanwhile, oak trees are declining, and so are pollinators. Due to severe droughts, long, hot, and dry summers, and overgrazing, Alentejo agriculture is unprofitable.

Value growth added is based on price growth as well as quantity growth. It continues with the price growth of output compared to the price growth of intermediate inputs. Finally, it includes waste and loss reduction and productivity increases among diversity and cash crops. The value added by the producer can be subdivided into value added at the farm gate (farm value), value added in the supply chain, value added at the wholesale/retail level, and value-added at the consumer level. The farm gate value is the sum of the producer's revenue plus the total costs to the producer, including all production costs. The supply chain value added is the sum of the producer's payments minus all production costs incurred in the supply chain.

Additionally, young generations leaving the countryside to live in the cities have left agriculture in a meagre state. The attempts to reforest in the area, such as those in the area, have been unsuccessful (with low success rates of planting material) or have created incomplete forest systems that are difficult to establish and very productive. Therefore regenerative agriculture is becoming more important as a solution for land degradation and the environment. The most significant agricultural activity in the region is dairy farming, which produces annually. In addition, there are small-scale vegetable growing, poultry, and beekeeping businesses. There are also some olive groves and vineyards, although they are not extensive. Agriculture in the region is not highly mechanised; most work is done by hand.

There has been a relatively steady increase in agricultural employment in the last few years. In 2010, 3,000 people worked in agriculture, while in 2018, there were 12,000 workers. The number of jobs has increased slowly since then, but the economic crisis has harmed the sector, and unemployment is high. There were 1,000 unemployed agricultural workers in the Alentejo region in 2018 (ENRD, 2021).

5.10.11 Double materiality of ESG

At this point, it no points in going in-depth into the diverse ESG frameworks. The interesting fact is the trap of thinking ESG equals sustainability as an automatic ticker box. The concept of double materiality refers to both internal and external risks a company faces in terms of sustainability and those it poses to society and the environment (Nemoto & Yoshino, 2021). Considering that your company is

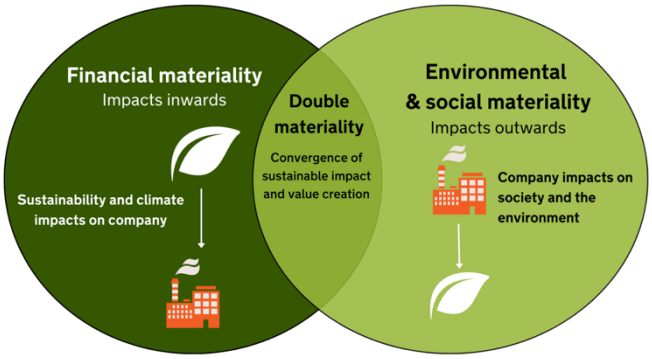

Fig. 28: *Double materiality | ESG.*

environmentally friendly should give you confidence in them. Material risks may affect your company's performance and bottom line. Investors may be interested in upgrading regenerative agriculture chains in addition to material risks. High-low and low-high matrices assess a company's vulnerability to environmental, social, and governance risks.

5.11 TCFD alignment with LEAP Framework

TNFD and its LEAP process evaluate the beta consultation framework for business feedback, accelerating progress in nature and biodiversity as the Taskforce on Nature-related Financial Disclosures (TNFD) align the TCFD with LEAP Framework (TCFD, 2022). To achieve sustainable, long-lasting improvements in nature and biodiversity, nature and biodiversity circles will be approached systematically. TNFD and TCFD address the climate-nature nexus using similar logic and lessons learned from TCFD implementation.

In the remaining part of 2022, TNFD, COP15, and ongoing sustainability work are expected to occur. In agriculture and agroforestry, several regulatory frameworks and mechanisms are involved. TCFD's recommendations align with global reporting standards. To adopt regenerative practices for agriculture and agroforestry, here are three pillars to understand LEAP. Please navigate to Annex D to evaluate the framework fully.

Language system

In the Taskforce on Nature-related Financial Disclosures (TNFD) framework, organisations deeply understand nature as a business issue. As TCFD categorises nature-related risks, TNFD assists them in understanding their impact and dependence on wildlife. In addition, supply chain disruptions and changes in demand result in financial difficulties.

Disclosure recommendations

The board and management must participate in governance, and differential financial planning is crucial. Global reporting standards require disclosure of the following topics, and TNFD builds on the TCFD pillars and disclosure elements. Additionally, nature risks must be integrated into broader risk management frameworks, such as handling nature risks. Performance metrics and targets must be integrated and measured.

Guidelines for LEAP

To manage nature risks, TNFD provides voluntary guidance. Through the LEAP process of locating, evaluating, assessing, and preparing, organisations are guided through critical questions and tasks to consider nature-related risks and opportunities. In addition, organisations must understand how assets and operations interact with nature to formulate strategic responses.

6 Discussion

A systemic, hybrid approach for both the grass-root level and the policymakers and regulators is needed to maximise the potential. An agricultural value chain (AVC) has been utilised throughout the thesis to uncover the nodes and see how the production chain works. Also, identify possible barriers and drivers primarily rooted in the integrated management (Sroufe, 2018, pp. 94-95). Shortly, regenerative agriculture in the Alentejo region of Portugal is connected to sustainability and food sovereignty, moving away from food security alone, based on diversity and richness across species (Dagar et al., 2020, p. 648). For this matter, a circular economy method is implemented. In this sense, the main objective of this work was to evaluate the system's effectiveness in terms of the quality of products and the level of accessibility to the market.

To keep balance and the contextual matter intact across the thesis, it was essential to dig into the hybrid approach with its combined social and ecological innovation in the Alentejo region of Portugal. I started this thesis started by outlining a research question, and to conclude this research, this chapter, therefore, aims to examine and discuss key findings in the light of the research question:

In Portugal's Alentejo region, how can a hybrid approach and innovation lens be applied to achieve a systemic transition from monoculture to regenerative agriculture?

6.1 Transparency and collaboration

Despite the complex policies, a solid willingness to collaborate can be observed in the agricultural value chain, especially in Southern Portugal. The agricultural value chain is complex because of its many players, but it is also a highly interconnected and interdependent (Devaux et al., 2018) . In addition, there are numerous challenges. It is not

only the lack of public funding but also the need for more public awareness of regenerative agriculture that is a challenge. For example, farmers need to learn how to use regenerative agriculture. For this, their leaders will need to organise them into more structured groups further to gain a higher chance for the export of organic fruits etc., across Europe. A case study of regenerative agriculture in southern Portugal A study was conducted on regenerative agriculture practices in Southern Portugal, which I visited for one week.

My findings were as follows. First, the area is relatively well-organised, but the need for more public funding and public awareness of regenerative agriculture is challenging. This can be seen in how the agricultural value chain is organised. The farmers are primarily contained in associations that deal with issues related to their farms, such as organic certification or pesticide application. However, the need for more public awareness of regenerative agriculture is also a challenge. Regarding this matter, reNature does a great job, as I am writing, by attending multiple conferences and high-level meetings that are visible across social media.

Second, the lack of funding is also a challenge, as seen from the lack of support for research and development in the area. Furthermore, the lack of financial incentives to implement regenerative agriculture, the lack of access to land and the difficulty of obtaining credit makes it difficult for farmers to invest in this type of farming.

Third, the need for regulation is challenging, making it difficult to sell organic products to consumers. Lastly, the lack of education is also a challenge, making it difficult to teach farmers about regenerative practices. Education and knowledge-sharing are needed to enable farmers to improve their agricultural practices and meet the challenges of climate change. Today, active model farming and workshop activities are well utilised to increase knowledge and awareness of Alentejo's innovative approach to precision farming.

6.2 System-building activities for RA

A new EU biodiversity strategy 2030 aims to protect biodiversity and ecosystems and enhance knowledge about their value in Europe. The EU is increasingly held accountable for biodiversity because of its environmental impact (Anderson et al., 2019). Additionally, there is a need to promote biodiversity-friendly practices, technologies, and policies and promote the sustainable use of biodiversity and ecosystems. Its origin is the EU Biodiversity strategy

2011-2020. In addition, as seen in the Alentejo plot, the system aims to develop a common policy framework for biodiversity in the EU and improve cooperation between national, regional, and local stakeholders.

The challenges involved in establishing such a policy framework can be summarised as follows through my on-site experiences. Since the EU biodiversity strategy and its implementation are not directly within the EU's legal power, involving all relevant stakeholders, including non-governmental organisations (NGOs), is essential. Second, since the EU is small and diverse, it must work with many partners. It is necessary to identify critical areas where the EU can be more effective early so it has a coherent vision of how it can make a positive contribution. The definition of what constitutes "good" or "sustainable" farming and forestry is crucial to regenerative agriculture and agroforestry (Bignal & McCracken, 2000). Furthermore, the EU should focus on identifying promising practices rather than implementing policies that may need to be improved. By leveraging the knowledge from such initiatives, the EU can build more effective approaches to leverage critical natural resources.

There are two reasons why international organisations have been so active in the conservation and development of biodiversity, including the United Nations (UN) and the World Bank. They promote sustainable development and environmental protection as part of their mandate. Secondly, as the UN has recognised, biodiversity loss threatens many aspects of sustainable development, including food security, water supply, energy, and climate change.(Bergamini et al., 2013) As it affects the productivity of crops and livestock and the health of plants and animals, biodiversity loss is also considered a threat to agricultural futures. Additionally, farming systems are affected by the degradation of soils and water resources and the failure of natural habitats. To avoid these threats, sustainable farming practices must contribute to biodiversity conservation over a long period.

6.3 Sustainable finance mechanisms of regenerative agriculture

The sustainable finance mechanisms of regenerative agriculture and forestry are vital to developing a regenerative economy. They allow financial institutions to support the growth of regenerative agriculture and forestry and rural communities and economies through sustainable finance.

First, regenerative agriculture and forestry have been considered niche markets for the last two decades. In particular, there needed to be more financial institutions willing to invest in and support regenerative agriculture and forestry. This has been changing recently as more financial institutions have been interested in investing in and supporting this sector.

Second, there need to be more regulatory frameworks to guide financial institutions. For example, while there are standards for other agricultural sectors, such as organic farming, there are no standards to guide regenerative agriculture and forestry.

Third, there needs to be more capacity within financial institutions to provide financial products that can help support the growth of regenerative agriculture and forestry. This is partly because many financial institutions need to become more familiar with regenerative agriculture and forestry, which limits their ability to provide products aligned with the needs of regenerative agriculture and forestry.

Fourth, there needs to be more understanding among farmers, investors, and financial institutions of the potential for regenerative agriculture and forestry (Carrington, 2020). In particular, there needs to be more understanding of how regenerative agriculture and forestry can be used to meet the needs of rural communities.

To tackle the currently fragmented financial possibilities, the region of Alentejo should work on establishing a regional strategy that will help finance and support the growth of regenerative agriculture and forestry. Further, navigate through the LEAP framework by TCFD in combination with EU Biodiversity Strategy, whereas tackling one target at a time.

6.4 Monitoring and evaluation for an outcome-based approach

Quinta das Abelhas with its strategic partners, including the integration of precision farming, helps document the results to build a more viable case of regenerative agriculture. Comparing the soil quality and available nutrients is an excellent way to the organic food market. That is linked to organised efforts in the community to spread the word and be more robust against lead firms. The result is much data that will allow us to see the impact of our actions, e.g. as seen on the screenshots from Farm21's impact platform (Restor, 2022). This is the first time that Quinta das Abelhas is conducting a research project, and we are trying to use the experience and knowledge to help other farmers. It is crucial to use the data and results to

understand our work's impact better. We are also using it to develop new strategies, projects and business models that can be applied to other regions and countries.

The future of agriculture

Three main trends will shape the future of agriculture: climate change, population growth and the availability of resources. Climate change affects agriculture in many ways, and the effects are becoming more severe each year. As the global temperature rises, more extreme weather events will occur, and less agricultural land will be suitable for production. In addition, the rising sea levels will make it increasingly challenging to protect agriculture against flooding. We are currently facing the worst droughts in history.

6.5 Feasible application for RA in the Alentejo region

Regenerative Agriculture in the Alentejo Region of Portugal Sustainable intensification of agricultural production is crucial in achieving future generations' food security and economic sustainability. In this sense, the transition from the current model of the agricultural output towards sustainable intensification and an agro-ecological based system is essential. The change will be particularly challenging in Portugal, which already has low agricultural productivity and limited land resources.

The Alentejo region (Portugal) is one of the most important agricultural regions in the country, with a high agrarian productivity level and a significant potential for sustainable intensification of the farming systems. This study aims to assess the feasibility of applying regenerative agriculture practices in the Alentejo region regarding ecological, social and economic aspects, agronomic and technical aspects, and farmers' perceptions (Chaudhuri et al., 2021, p. 13). The critical elements lie at the farmer's level: (i) socio-economic factors; (ii) technical factors; (iii) agronomic factors, and (iv) farmers' perceptions. This study applied the following practices: no tillage, integrated crop-livestock systems, intercropping, conservation tillage, cover crops, no-chemical practices, no pesticides and no fertilisers. The results showed that the rules positively impact the farmers' income, soil quality, carbon sequestration, water quality and soil biodiversity.

Furthermore, applying these practices in the Alentejo region can contribute to mitigating climate change impacts, achieving food security, and achieving the UN Agenda 2030 targets related to environmental sustainability, climate change mitigation and adaptation. The

transition from the current model of agricultural production towards sustainable intensification and an agro-ecological based system is essential. In this sense, the transition will be particularly challenging in Portugal, which already has low agricultural productivity and limited land resources.

On the opposite side, the strength of utilising regenerative agriculture at scale builds on high nutritional value, is robust against extreme weather such as heat and frost, and has a long lifespan. This is good news for farmers and consumers; reNature and their partners are on a great track in Alentejo, Portugal.

6.6 Bottlenecks?

Future generations' economic sustainability and food security depend on the sustainable intensification of agricultural production. Agroecological systems based on sustainable intensification should replace current agrarian production models (Goswami et al., 2021). As Portugal already has low farm productivity and limited land resources, the transition will be incredibly challenging.

Portugal must adopt a new land use planning and management paradigm to achieve this goal. Specifically, a system of land management that incorporates sustainable intensification and agroecology as principles. The report also briefly assesses the critical obstacles to developing regenerative agriculture in the Alentejo region and transitioning to sustainable intensification. By conducting a regional assessment of soil and water quality in the Alentejo region, for example, on my field trips, I identified bottlenecks to scaling up regenerative agriculture. This assessment led to several recommendations. This includes a coordinated approach to evaluating soil and water quality and the urgent need to establish a framework for monitoring and reporting the results of soil and water quality assessments. Third, future monitoring and reporting systems must incorporate an appropriate spatial modelling approach, develop a comprehensive set of indicators for assessing and monitoring soil and water quality and include a variety of indicators.

6.7 Regenerative agriculture: Enabling factors

People's lives and livelihoods are directly affected by agricultural productivity, a significant factor in the global economy. Agricultural production and consumption patterns have become increasingly unsustainable, harming the environment, health, nutrition, and biodiversity. As a

result, technological advances and social factors, such as organised trading groups, compared to non-organised farmers, are driving fundamental changes in the food system.

Increasing food production has resulted in an increasing reliance on chemical inputs, which has caused soil degradation, water contamination, land degradation, biodiversity loss, and the buildup of GHG. A new paradigm in agriculture referred to as 'regenerative agriculture,' has been born in response to concerns about agricultural practices negatively affecting climate change and human health. Regenerative agriculture seeks to achieve high levels of productivity while simultaneously minimising degradation and maintaining the ability of ecosystems to provide essential goods and services to humans.

Regenerative agriculture has become a global trend, driven by adopting sustainable intensification principles and ecological and social innovation by recognising that farming systems need to be integrated with nature. Regenerative agriculture is not new; however, it is gaining momentum as more people understand the consequences of current practices on agriculture and the environment. More strategic partnerships can occur by systematically connecting the nodes in the agricultural value chain, making the Alentejo region business case for AFS and RA viable and long-term.

6.8 Farm-scale benefits: Regenerative agriculture

In addition to crop yield, water productivity, and soil organic matter, a larger area has economic benefits. Secondly, there is the environmental value of increasing biological diversity and storing carbon in the soil (Elevitch et al., 2018). Thirdly, there is the social value of better livelihoods and local food systems. A substantial shift towards regenerative agriculture will realise these benefits.

Among the most commonly used measures of the agroecosystem, success is yield, efficiency, and resilience. However, these measures only tell part of the story. For example, yield is only one indicator of agricultural productivity. It is, therefore, essential to measure more than yield if we are to determine the success of agroecosystems. As a result, farmers can grow more crops and use fewer inputs with agroecosystems that are more integrated with the environment.

As we rely more on these integrated agroecosystems, they become more efficient and resilient. Agroecosystems with integrated inputs produce more crops and use less information. In addition to reducing their environmental impact, they increase their biological diversity by using less fertiliser and pesticides. The variety of crops also allows farmers to spend less time managing pests and diseases, allowing them to focus on other tasks.

The economic value of ecosystem services

This section reviews the most critical literature regarding ecosystem services and agricultural intensification's economic value. The term ecosystem services refer to the value people derive from natural resources, such as clean air, clean water, and healthy soil, which are often provided by nature but are difficult or impossible to produce by humans (De Groot et al., 2003). The economic value of ecosystem services can be measured by measuring changes in land prices, household incomes and consumption patterns. For example, a healthy forest protects from floods, provides clean air and reduces fire risks.

An extensive body of research has now been conducted on ecosystem services' economic value. Approximately US$ 100 billion in this value has been estimated globally, with the highest values found in water provisioning, climate regulation, soil formation, and crop production (Dahlgren et al. 2011; Naeem et al. 2011). However, these numbers are difficult to interpret due to various uncertainties, including the difficulty in determining the monetary value of some ecosystem services (e.g. the importance of clean air) and the fact that some ecosystem services may have negative values.

The economic value of ecosystem services is defined as the benefits that people derive from natural resources, e.g. clean air, clean water, and healthy soils, which are often provided by nature but are difficult or impossible to produce by humans. For example, a healthy forest is valuable because it protects against floods, provides clean air and reduces the risk of fires. Furthermore, by utilising the technology of Farm21 and taking more soil examples, it feeds into a richer database for better decision-making.

7 Conclusion

Regenerative Agriculture is the agricultural practice where there is no use of pesticides, herbicides or synthetic fertilisers, and agroforestry practices, such as cover crops, green manures and livestock. This is in significant contrast to the conventional standard (monoculture). The idea of this practice is that there is a need to restore the natural balance between soil, water and plants.

RA can be done by using the soil's natural ability to decompose and recycle organic matter. This practice is particularly interesting for Alentejo, Portugal, which is currently undergoing a vital land reform process. Agroforestry systems require an upgrade and full utilisation due to their many benefits of shade and cover crops.

As a result of regenerative agriculture, biodiversity can be protected, soils can be preserved, dirt can be fertile, and water tables can be improved. Using fewer agrochemicals also helps reduce environmental pressure and the transition phase to RA (Dagar et al., 2020, p. 301). Regenerative agriculture has many benefits, including improved soil fertility and a reduction in environmental impact.

To achieve a sustainable future for the Alentejo region, regenerative agriculture must be addressed from the bottom up and from the top down. Farmers have an excellent opportunity to invest in their land and themselves and provide better food for their families. GrowBack and reNature will be able to boost yields, quality, and income within a year of partnering with Farm21.

A regenerative agriculture system is a modern agricultural system that strives to restore the natural balance between the soil, plant and water. This approach is based on the idea that soil is an ecosystem capable of recycling organic matter and sustaining itself through its natural processes. As a result, there is still a wide range of public subsidies and regulatory frameworks to navigate, yet we keep stumbling into them.

A hybrid approach to regenerative agriculture

The bottom-up approach is the foundation of regenerative agriculture. It is the first step to understanding what is needed to create healthy soil. Regenerative agriculture aims to produce

high-quality food and include the farmers while minimising environmental impacts. It combines best management practices and regenerative processes, providing long-term, sustainable benefits. Alentejo, Portugal's national and regional plans lie in the path of regenerative agriculture. The region is the leading producer of olive oil, wine and table olives, with an agroecological potential in more than 1000ha of organic production. Lastly, from the international level, top-bottom, its strength lies in regulations and policies to support the implementation of these actions. Regenerative agricultural practices improve the quality and quantity of soil and crop yields while reducing inputs and environmental impacts.

7.1 Looking ahead

Sharing knowledge and best practices is essential for scaling up regenerative agriculture across the region and reducing its environmental footprint. This practice is exciting in Portugal, where land reform is currently underway. Using regenerative agriculture with intelligent monitoring and innovation, biodiversity can be protected, soils can be preserved, fertility can be increased, and water levels can be enhanced. The diverse method reduces the negative environmental impact by using fewer agrochemicals.

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9 Appendices

Appendix A: Interview guides

Target group one: Decision makers at reNature

Interview guide for «Regenerative agriculture in Portugal.»

This master's thesis discusses a healthy transition from agriculture to regenerative agriculture through a hybrid approach between stakeholders, including farmers and EU regulations. Aside from increasing yields and biodiversity for farmers, Quinta das Abelhas can also sequester carbon. The farm, located on-site with Herdade do Freio de Meio, needs market research, structures, and opportunities to scale. Researchers' knowledge is clarified and sharpened by integrating subquestions throughout reNature's global value chain (GVC).

Instead of just carbon footprints, modern agricultural technology and bioacoustic devices measure biodiversity. Identifying key stakeholders who own this systemic approach helps me identify vital angles for my thesis. That is why you, as a farmer, must grasp the local knowledge on-site.

Research question:

How to optimise a systemic change through an innovation lens, from monoculture to Regenerative agriculture while evaluating barriers and drivers in Portugal's Alentejo region?

Background info

1. Could you tell me more about your core tasks and role in general on-site?
2. In terms of work ethics and conditions, how do you relate to reNature?

Administration and project development

1. How did Quinta das Abelhas get its start?
2. How many stakeholders are involved, and which are the most significant?
3. How does one select which project to fund and invest in?
4. Describe the strategic relationships connected to the Alentejo region. Who is in charge, and which role do they fulfil – overlapping and execution in practice?
5. Which key pillars reNature builds upon in their work concerning the stakeholders, time and project development?
6. Given its massive base of strategic partners, how does reNature foster innovation and healthy project management over time?

Innovation and biodiversity measurements

1. How to measure best practices and move through stages of the project – from idea to maintenance and eventually scaling up regenerative agriculture?
2. The innovative measurement devices on site are of practical value for documentation purposes. How do they work in practice and adapt to the Portuguese region of Quinta das Abelhas, the Alentejo?
3. What makes the region stand out for a regenerative angle towards increased biodiversity and its outcomes for production in general?

4. Regarding soil quality and yields over time, what are the overall strategy components for ease of maintenance?

Drivers and barriers to scaling up on-site?

1. Are there any obstacles to kickstarting the project?
2. How have you kept the momentum moving from a top-down approach?
3. How does life cycle assessment fit in - from a local to national perspective?
4. Land rights and funding are not uncommon problems among conventional monoculture systems. How does this differ from regenerative modelling?
5. What are the critical barriers to general Quinta das Abelhas and regenerative agriculture?
6. What are the key critical enablers to Quinta das Abelhas and regenerative agriculture?
7. How to navigate the complexity of stakeholders so everyone gets their fair cut in a sustainable and responsible business model approach?
8. Precise measurements and detailed documentation are critical. On which scale does reNature handle this, and from which angle, given the complexity of data collection and agriculture technology (AgTech)?

Target group two: Farmers

Regenerative agricultural outcomes

1. What differentiates regenerative practices from monoculture?
2. What does no-tillage mean to soil management?
3. What are the key crops you grow and why?
4. How can this method of mimicking nature bring value for the agricultural outcome short and long term?
5. The window of opportunity for sustainable solutions is here. When do you and your team expect seed results to the export market?
6. What essential aspects do you value when working the land as a farmer?
7. How do you see the farm scaling from 0.5 ha to, e.g. 3 ha and beyond, given the partner, Herdade do Freixo do Meio's access to 600 ha in total?

Land rights | Farming practice

1. Land rights and funding are not uncommon problems among conventional monoculture systems. How does this differ from regenerative modelling?
2. What are the critical barriers to general Quinta das Abelhas and regenerative agriculture?
3. What are the critical enablers to Quinta das Abelhas and regenerative agriculture?
4. How do you manage the other farmers on-site?
5. How well would you evaluate the on-site organisational structure to maximise the output and growth of regenerative agriculture and agroforestry?

Innovation | Farming practice

1. How have you implemented Farm21's innovation tool to measure soil health linked to soil organic management (SOM)? Which effects have you experienced?
2. Have you been structured and trained to operate these small devices for the managers?
3. Measurement quality and documenting effects are neat. How well is this managed on-site and then transferred to the office of reNature?

Target group three: Strategic operators

Strategic developments | RA

1. What does a typical strategic analysis for regenerative agriculture look like? (land assessments) Which factors are being prioritised and why?
2. How can technology knowledge help foster a better angle and maintenance of regenerative agriculture aspects in a syntropic context? Then, how can it be accumulated and shared as a resource?
3. How does one select which project to fund and invest in?
4. Describe the strategic relationships connected to the Alentejo region. Who is in charge, and which role do they fulfil – overlapping and execution in practice?
5. Which key pillars reNature builds upon in their work concerning the stakeholders, time and project development?
6. Given its vast base of strategic partners, how does reNature foster innovation and healthy project management over time?

7. How do you do risk assessments and share the benefits of the individual stakeholders?

Data management & impact platform

1. How can the project/data management platform increase resourcefulness and energy efficiency at scale?
2. What are the current constraints to the measurements, and how to ensure quality data inputs and outputs over time?

Operations and finance

1. How crucial are sustainable finance mechanisms to reNature to facilitate change in the regenerative agricultural sector?
2. From an SME perspective, how does reNature lead by example and challenge the status quo through its operations within regenerative farming, e.g. syntropic agriculture in Portugal?
3. How would linking industrial clusters to regenerative farming help scale the concept within the private sector? Outcomes (environmental, social, governmental guidelines)
4. What are the typical barriers and enablers for the growth of regenerative farming in southwest Portugal?

European soil

1. What defines a successful, scalable operation from monoculture to regenerative farming for the private sector?
2. Are you familiar with the EU emission Trading Scheme (ETS) carbon trading platform? How does this relate to increasing consciousness for carbon and biodiversity assessments for positive circles of influence regarding stakeholders and the environment?

Innovation and biodiversity measurements

1. How to measure best practices and move through stages of the project – from idea to maintaining and eventually scaling up regenerative agriculture?
2. The innovative measurement devices on site are of practical value for documentation purposes. How do they work in practice and adapt to the Portuguese region of Quinta das Abelhas, the Alentejo?

3. What makes the region stand out for a regenerative angle toward increased biodiversity and its outcomes for production in general?
4. Regarding soil quality and yields over time, what are the overall strategy components for ease of maintenance?

Drivers and barriers to scaling up on-site?

1. How have you kept the momentum moving from a top-down approach?
2. How does life cycle assessment fit in - from a local to national perspective?
3. Land rights and funding are not uncommon problems among conventional monoculture systems. How does this differ from regenerative modelling?
4. What are the critical barriers to general Quinta das Abelhas and regenerative agriculture?
5. What are the critical enablers to Quinta das Abelhas and regenerative agriculture?
6. How do we navigate the complexity of stakeholders so everyone gets their fair cut in a sustainable and responsible business model approach?
7. Precise measurements and detailed documentation are essential. On which scale does reNature handle this, and from which angle gave the complexity of data collection and agriculture technology (AgTech)?

Target group four: PhD Research on EU Taxonomy and Sustainable Finance

Interview guide for «Regenerative agriculture in Portugal»

This master's thesis discusses creating a healthy transition from agriculture to regenerative agriculture through a hybrid approach between stakeholders from farmers to EU regulations. Moreover, Quinta das Abelhas can grow and scale while increasing yields and biodiversity levels for its farmers and sequestering carbon. In other words, market research, structures, and market opportunities help Quinta das Abelhas grow and scale. Throughout reNature's global value chain (GVC), subquestions are integrated to clarify and sharpen one's knowledge as a researcher.

In addition to the data management platform, modern agricultural technologies and bioacoustic devices are used to measure biodiversity rather than just carbon footprints. From

there, I reflect on vital angles for my thesis by identifying key stakeholders who own this systemic approach.

Research question:

How to optimise a systemic change through an innovation lens, from monoculture to Regenerative agriculture while evaluating barriers and drivers in Portugal's Alentejo region?

Background info

1. Could you tell me more about your position and background in the EU Taxonomy?

2. What do you think of when I say sustainable finance? How would you define this area?

3. What are typical EU Taxonomy-eligible activities?

EU Taxonomy & Sustainable Finance

1. How do you evaluate the EU's (European Union) Green Deals' link with the EU Taxonomy? Primary outcomes from these regulations, considering the increasing awareness of the sustainable shift?
2. Which top three criteria in EUs Taxonomy are the most demanding for (SMEs to implement?
3. Explain the EU Taxonomy compass focusing on collateral policies for a strategic approach that potentially increases the PPP (private-public partnerships) in the process.
4. EU Taxonomy is a classification system where reliable data is essential. How does one ensure this is sustained overall within the EU Taxonomy framework?
5. How can one connect the nodes of sustainable finance to regenerative agricultural practices and intelligent land management?
6. Who should comply with EU Taxonomy, and is it legally binding?

Sustainable due diligence

1. What are the key components here that SMEs should focus on?
2. Are there notable and highly contrasted differences between SME's angle vs multi-national firms' angle to this?
3. Why do SFDR and EU Taxonomy regulations overlap, facilitating sustainable norms and legal rules?
4. How does one link and explain ESMA (European Securities and Markets Authorities) 's to ESG (Environmental Social Governance) requirements? GRI?
5. Would you elaborate more on non-financial directive vs SFDR?

6. How important is it to connect organised farmers through regional, national and supernational regulations, and why? What hinders this from happening on a bigger scale?

Appendix B: Consent form

Are you interested in taking part in the research project *"Regenerative agriculture in Portugal"*?

Purpose of the project

This is an inquiry about participation in a research project where the primary purpose is to analyse global production network and supply chain management from the grass-root level up to the EU level regarding frameworks, guidelines and how stakeholders are involved. From market research, structures, and market opportunities, look at how the Quinta das Abelhas can mature and scale from the current stage at a reNatures public timeline. In this letter, I will give you information about the purpose of the project and what your participation will involve.

Research question: The purpose of this master project is to answer the following problem: *How to optimise a systemic change through an innovation lens, from monoculture to regenerative agriculture, while evaluating barriers and drivers in Portugal's Alentejo region?*

The scope is about actively studying reNature's work over one year and is thus very comprehensive to ensure good data and development over time. The work includes several interviews and document analyses linked to a hybrid understanding, from the top with the EU's strategy on biodiversity to farmers' organisation and rights. This includes reNature's role as an active facilitator and link to educate farmers with new knowledge of sustainable agricultural practices, including innovations for documented results. To put together this dynamic picture, it is natural to integrate a more profound understanding – of socio-cultural regulations across the production chain. This is how the task is shaped to provide reliable utility to various stakeholders, where each party can experience a win-win dividend of time, energy and resources invested. Below are my two research questions, which underpin my problem.

- R2: What is the best way to scale regenerative agriculture in Southern Europe to increase healthy biodiversity and ensure valuable returns for stakeholders?
- R3: What regulations, from a local to an EU level, enable the GVC to evaluate and implement carbon and biodiversity initiatives successfully?

The information collected should not be used for purposes other than this master project. The knowledge gained will help lift the farming practice to a new and better level with this knowledge so that the utility here points to increased food security and inclusion of stakeholders while reducing greenhouse gases that occur in the process.

Which institution is responsible for the research project?

The Department of Geography at the Norwegian University of Science and Technology (NTNU) is accountable for the project. The work collaborates with reNature across their locations in Amsterdam and Portugal.

Why are you being asked to participate?

You have been drawn as an informant for your work and specialisation on regenerative practices and their link to reNature, impacting the sustainable aspect through innovation. This

knowledge helps navigate the likelihood and systemic analysis for maintaining and scaling up the practice of regenerative agriculture in syntropic conditions. For this matter, mainly an extra focus on the Alentejo region, but not solely limited, as a comparison to neighbour territories, incl. *montado*, which are of interest for agroforestry developments.

What does participation involve for you?

If you choose to participate in the project, you attend an interview. It will take approx. 40-60 minutes. The questions in the discussion will address your work and experience in the field. It will be taken as a sound recording of the interview if that is okay with you. Here, the information will be stored in the hardware of the treatment institution. Notes will be taken next to them to emphasise points and context in the dialogue further.

Participation is voluntary

Participation in the project is voluntary. If you choose to participate, you can withdraw your consent without giving a reason. All information about you will then be made anonymous. You will have no negative consequences if you choose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data

We will only use your personal data for the purpose(s) specified here, and we will process your personal data in accordance with data protection legislation (the GDPR).

- Only the student and any supervisor will have access to the information. Supervisor is Alexander Dodge, Associate Professor at the Department of Geography at NTNU
- Personal information is stored on hardware belonging to the processing institution and deleted at the end of the project.

Names are omitted in the publication of the assignment, while the workplace remains. It will thus be small the opportunity to recognise the informant as a result of the workplace, where no one else personal data is provided. This is to protect the informants and their privacy.

What will happen to your personal data at the end of the research project?

The planned end date of the project is 15.11.2022. After successful completion and delivery, I will defend my master's thesis. Afterwards, all-digital recordings will carefully be erased safely. The information collected will be anonymised for names but include the respective firm(s) connected, e.g., strategic partnerships, to elaborate on levels of development for society and its implications in practice for optimal learning for my audience.

Your rights

So long as you can be identified in the collected data, you have the right to:

- access the personal information that is being processed about you
- request that your personal information be deleted
- request that incorrect personal data about you be corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Norwegian Data Protection Authority regarding the processing of your personal data

What gives me the right to process your personal data?

I will process your personal data based on your consent.

Based on an agreement with NTNU: Norwegian University of Science and Technology, Data Protection Services has assessed that the processing of personal data in this project meets requirements in data protection legislation.

Where can I find out more?

If you have questions about the project or want to exercise your rights, contact:

• *Fredrik Asche Kaada (student) on tel: +47 46500745 or e-mail: fredrasc@stud.ntnu.no*
• *Alexander Dodge (Associate professor at the Department of Geography at NTNU) on tel: +4773591911 or email: alexander.dodge@ntnu.no*
• *Thomas Helgesen (Privacy Ombudsman at NTNU) on tel: +47 93079038 or e-mail: thomas.helgesen@ntnu.no*

If you have questions about how data protection has been assessed in this project, contact:

- Data Protection Services, by email: (personverntjenester@sikt.no) or by telephone: +47 53 21 15 00.

Yours sincerely,
Alexander Dodge (Project Leader/Researcher),
Fredrik Asche Kaada (Student, MSc in Innovation, Entrepreneurship and Society at NTNU)

Consent form

I have received and understood information about the "Regenerative agriculture in Portugal" project and have been allowed to ask questions. I give consent:

- ☐ to participate in an interview
- ☐ that information about my place of work is published
- ☐ to be interviewed on location (Portugal / Netherlands)

I give consent for my personal data to be processed until the end of the project.

(Signed by participant, date)

Vil du delta i forskningsprosjektet

"Regenerativt jordbruk i Portugal"?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke barrierer og drivkrefter omkring skalering av et regenerativt jordbruk (les: bærekraft) i Portugal. Da tas innovasjon og systemforståelse med i bildet. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Formålet med dette masterprosjektet er å besvare følgende problemstilling: *How to optimise a systemic change through an innovation lens, from monoculture to regenerative agriculture, while evaluating barriers and drivers in Portugal's Alentejo region?*

Omfanget dreier seg om å aktivt studere reNature's arbeid over 1 ½ år, og er dermed svært omfattende arbeid for å sikre gode data og utvikling over tid. I arbeidet inngår en rekke intervjuer og dokumentanalyser linket til en hybrid forståelse; fra toppen med EUs strategi på biologisk mangfold til bønders organisering og rettigheter. Dette innbefatter òg reNature's rolle som aktiv fasilitator og bindeledd for å utdanne bønder med ny kunnskap om bærekraftig jordbruksprаksis, inkludert nyvinninger for dokumenterte resultater. For å sette sammen dette dynamiske bilde er det naturlig å integrere en dypere forståelse – sosiokulturelt og reguleringer som finnes på tvers i produksjonskjeden. Slik formes oppgaven til å gi solid nytteverdi av en rekke interessenter, hvor hver part kan oppleve et vinn-vinn utbytte av tid, energi og ressurser investert. Nedenfor er mine to forskningsspm. som underbygger min problemstilling.

- R2: What is the best way to scale regenerative agriculture in Southern Europe to increase healthy biodiversity and ensure valuable returns for stakeholders?
- R3: What regulations, from a local to an EU level, enable the GVC to evaluate and implement carbon and biodiversity initiatives successfully?

Opplysningene som hentes inn skal ikke brukes til andre formål enn dette masterprosjektet. Kunnskapen tilegnet skal bidra til å løfte jordbruksprаksisen til et nytt og bedre nivå med denne kunnskapen, slik at nytteverdien her peker mot økt matsikkerhet og inkludering av interessenter, samtidig som minskning av klimagasser skjer i prosessen.

Hvem er ansvarlig for forskningsprosjektet?
Institutt for Geografi ved NTNU er ansvarlig for prosjektet. Arbeidet er et samarbeid med reNature på tvers av deres lokasjoner i Amsterdam og Portugal.

Hvorfor får du spørsmål om å delta?
Du er trukket ut som informant med tanke på ditt arbeid og spesialisering omkring EUs taksonomi, med virkning på det bærekraftige aspektet. Det er nyttig med denne kunnskapen for å navigere lover og retningslinjer tilknyttet jordbrukssektoren, og ikke minst fra et top-down perspektiv.

Hva innebærer det for deg å delta?

Hvis du velger å delta i prosjektet, innebærer det at du deltar på et intervju. Det vil ta mellom ca. 40-60 minutter. Spørsmålene i intervjuet vil omhandle ditt arbeid og erfaringer på feltet. Det kommer til å bli tatt lydopptak av intervjuet, dersom det er i orden med deg. Her vil opplysningene lagres på maskinvare tilhørende behandlingsansvarlig institusjon. Det vil òg bli tatt notater ved siden av ved behov for å ytterligere understreke poeng og kontekst i dialogen.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

- Det er kun studenten og eventuelt veileder som vil ha tilgang til opplysningene. Veileder er Alexander Dodge, Førsteamanuensis ved Institutt for Geografi på NTNU
- Personopplysninger blir lagret på maskinvare tilhørende behandlingsansvarlig institusjon og slettes ved prosjektets slutt.

Navn utelates i publikasjonen av oppgaven, mens arbeidssted forblir. Det vil dermed være liten mulighet for å gjenkjenne informanten som følge av arbeidssted, hvor heller ingen andre personopplysninger oppgis. Dette for å verne omkring informantene og deres personvern.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er 15. november 2022. Ved prosjektets slutt vil lydopptak, bilder og eventuelt andre kilder (f.eks. notater) med personopplysninger slettes.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Institutt for Geografi ved NTNU har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med Personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Fredrik Asche Kaada (student) på tlf: +47 46500745 eller epost: fredrasc@stud.ntnu.no
- Alexander Dodge (førsteamanuensis ved Institutt for Geografi på NTNU) på tlf: +47 73591911
  eller epost: alexander.dodge@ntnu.no
- Thomas Helgesen (Personvernombud ved NTNU) på tlf: +47 93079038 eller epost: thomas.helgesen@ntnu.no

Hvis du har spørsmål knyttet til Personverntjenester sin vurdering av prosjektet, kan du ta kontakt med:

- Personverntjenester ved SIKT på epost (personverntjenester@sikt.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Alexander Dodge (Forsker/veileder),
Fredrik Asche Kaada (Student)

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «Regenerativt jordbruk i Portugal» og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i digitalt intervju med lydopptak
- ☐ at opplysninger om mitt arbeidssted publiseres

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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(Signert av prosjektdeltaker, dato)

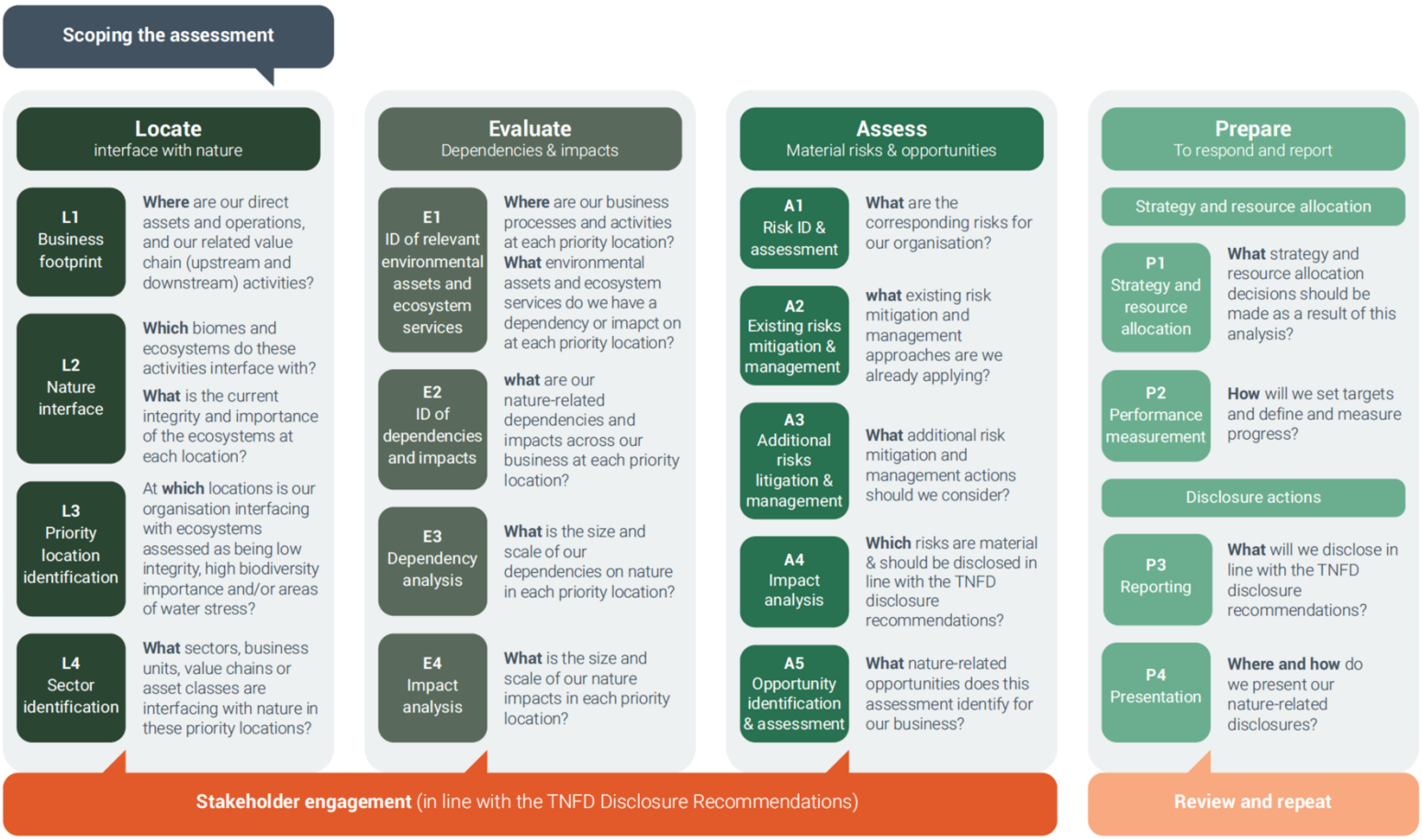
Appendix C: Overview of selected documents for analysis

Document type	Document name	Publisher	Year of publication
Strategy	"EU Biodiversity Strategy 2030"	European Union (EU)	2020
Report	"CAP performance 2014-20"	Common monitoring and evaluation framework (CMEF) & EC	2021
Strategy	"EU Farm to Fork Strategy"	European Commission (EC)	2020
Report	"IPCC Sixth Assessment Report" - Impacts, Adaptation and Vulnerability	Intergovernmental Panel on Climate Change (IPCC)	2022
Strategy	"EU Green Deal"	European Commission (EC)	2019
Strategy	"EU taxonomy for sustainable activities"	European Commission (EC)	
Strategy	"EU Soil Strategy 2030"	European Union (EU)	2021

Report	"Portugal: Third National Report"	Institute for Nature Conservation (ICN) & government of Portugal	2021
Report	"European Climate Pact"	European Union (EU)	
Report	"EEA Signals 2019"	European Environment Agency (EEA)	2019
Report	Regenerative agriculture in Europe - A critical analysis of contributions to the European Union Farm to Fork and Biodiversity Strategies	European Academies Science Advisory Council (EASAC)	2022
Report	"FAO-FiBL Workshop – An knowledge exchange forum for greening of food value chains"	Food and Agriculture Organization of the United Nations (FAO)	2014
Report	"The state of food security and nutrition in the world" (SOFI)	Food and Agriculture Organization of the United Nations (FAO)	2021
Report	"Updated Inventory and Assessment of Soil Protection Policy Instruments in EU Member States"	Ecologic Institute, Berlin	2017
Report	"Biodiversity Financing and Tracking"	European Commission (EC)	2022
Report	Support to the Evaluation of the EU Biodiversity Strategy to 2020, and Follow-Up"	European Commission (EC)	2022
Report	"A greener and fairer CAP"	European Commission (EC)	2022
Report	"Global Biodiversity Outlook 5"	United Nations Environment Programme (UNEP) & Convention on Biological Diversity (CBD)	2020

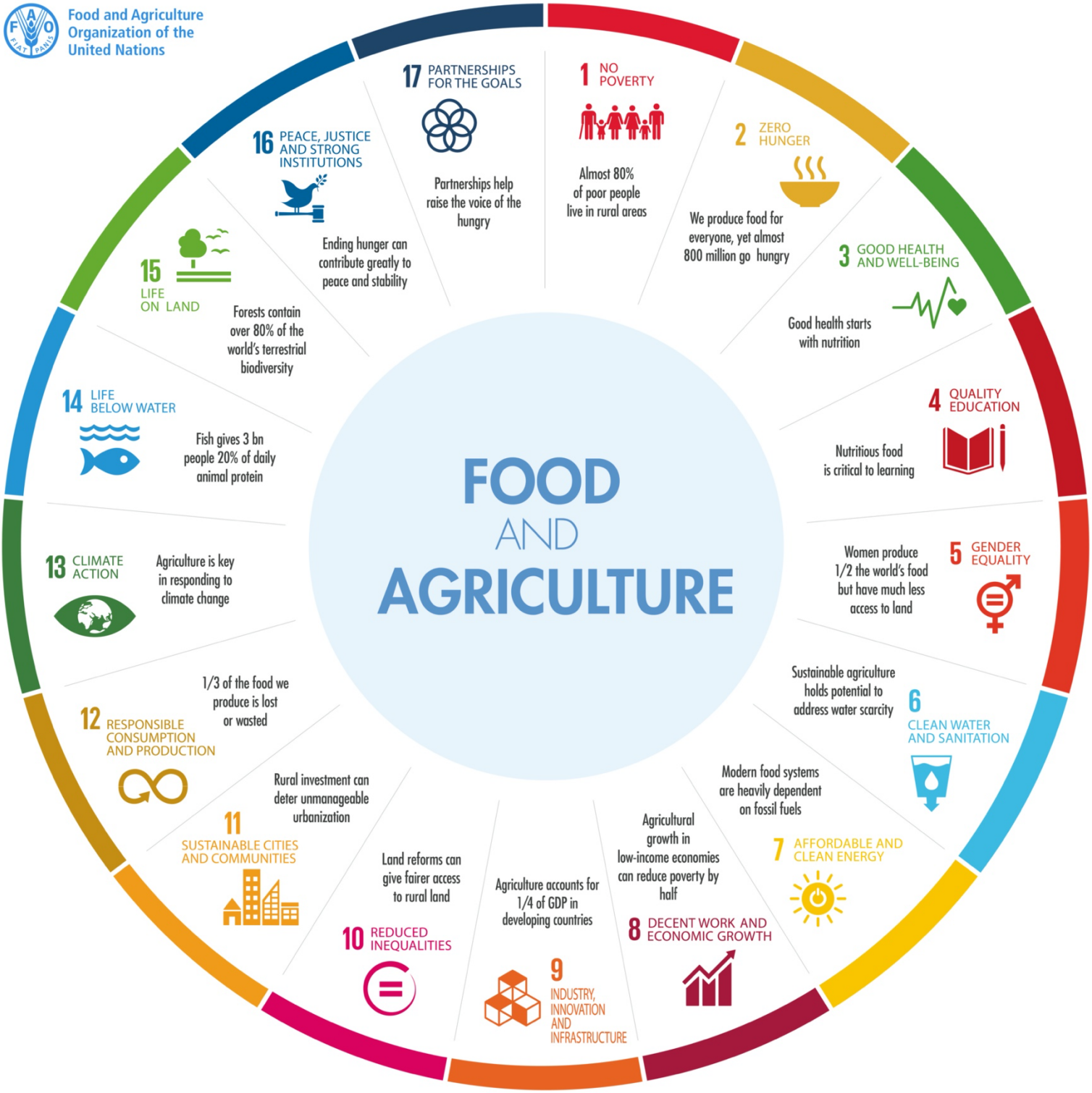
Appendix D: LEAP Framework alignment to TCFD

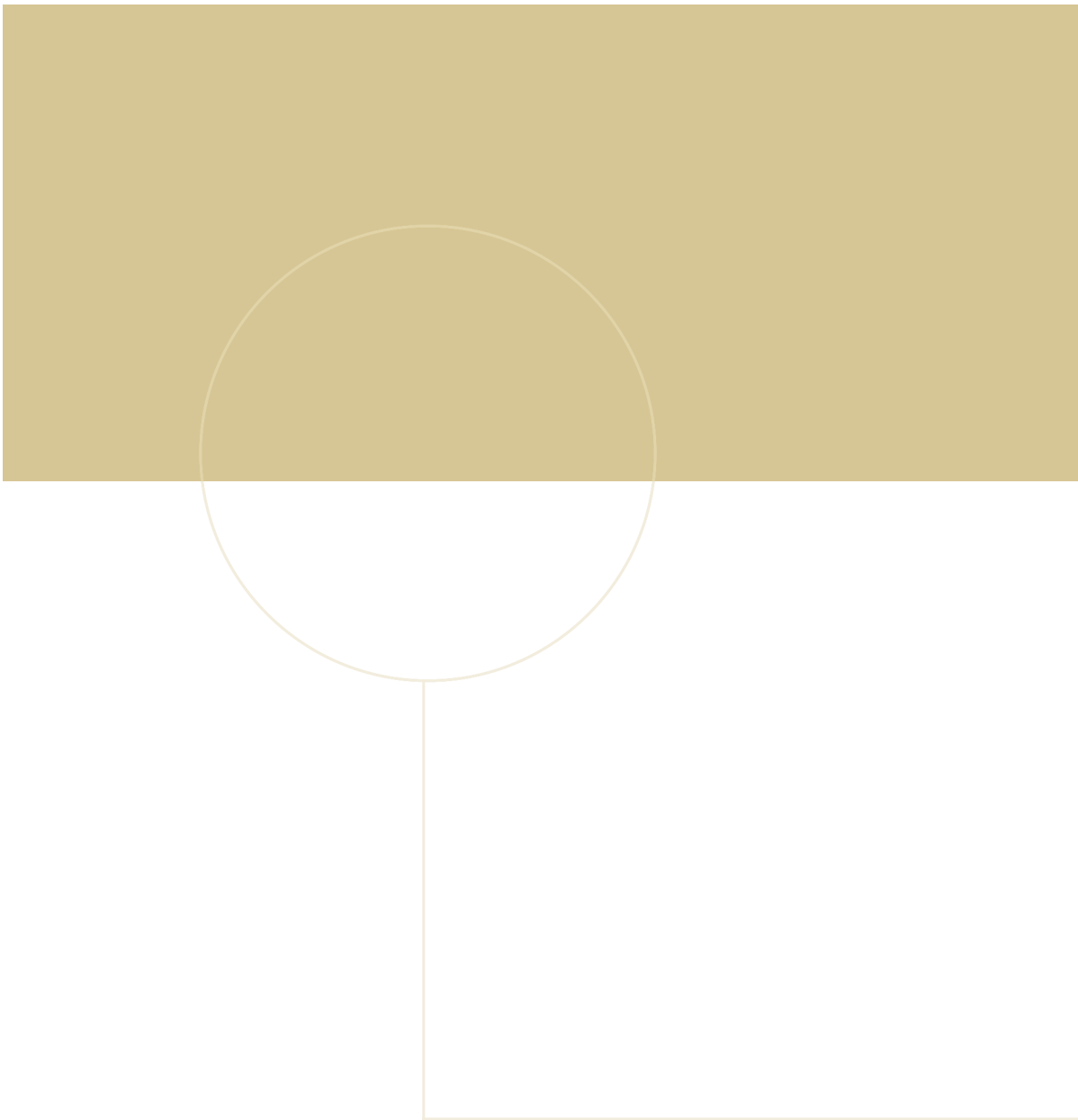
The LEAP approach



Source: The TNFD Nature-related Risk & Opportunity Management and Disclosure Framework - Beta v0.1 Release

Appendix E: Food and Agriculture in the 2030 Agenda | FAO infographic





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