InnoForESt

Smart information, governance and business innovations for sustainable supply and payment mechanisms for forest ecosystem services

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D3.1: ANALYSIS FRAMEWORK FOR THE GOVERNANCE OF POLICY AND BUSINESS INNOVATION TYPES AND CONDITIONS

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Summary

This analysis framework for the governance of policy and business innovation types and conditions serves as an analytical lens to support the exploration of influencing factors on governance innovations to secure a sustainable provision of forest ecosystem services. The creation of the analysis framework builds on the idea of complex processes within linked social-ecological-technical-forestry-innovation systems (SETFIS) of the InnoForESt case study innovations.

The goal of the framework is to benefit project partners of InnoForESt to gain a decent understanding of what factors can influence governance innovations, from early ideas of its emergence and developments until now (retrospectively), and what is needed to initiate similar innovation elsewhere, or for an improved version of the innovation in the current context (prospectively). Governance innovations in the context of InnoForESt are defined as new networks and actor alliances as well as payment schemes, but may also refer to hybrids, new policy mixes, processes and novel forms of organisation.

The analysis of the development of such governance innovations, using the InnoForESt SETFIS analysis framework, will provide insights on key influencing factors to arrange concrete recommendations for actions, which will further improve and spread the innovation, e.g. support stakeholder collaboration, institutional adjustments, management and business adaptations, or reducing the influence of devastating influences.

To describe the system dimensions, factors and interlinkages, we use different theories and concepts from social-ecological research, sustainability sciences, innovation studies and political science, as a basis for the analysis framework. The interdisciplinary nature of the analysis framework supports a comparative analysis over a range of different case study conditions and innovation types while acknowledging the complexity of forestry innovation systems.

The systems consist of the following *system dimensions* that are covered by the SETFIS analysis framework:

Dimension 1 – Actors (Governance System)	Dimension 5 – Innovation System
Dimension 2 – Institutions (Governance System)	Dimension 6 – External Influences
Dimension 3 – Biophysical Conditions	Dimension 7 – Governance Innovation Process
Dimension 4 – Forest Management System	

The seven dimensions are subdivided into sets of influencing factors of governance innovations, e.g. power relations and ownership of actors, regulatory or incentive-based policy instruments for institutions, or different forest management strategies for Forest Management System. The term *factor* refers to observed conditions or processes that influence the innovation and its development process.

The identified dimensions and factors are translated into questions for practical application of the framework in the Innovation Regions of InnoForESt. Therefore, the list of questions can be used as a backing tool for elaboration and analysis, which helps to identify the range and degree of factors that have potentially influenced (fostering/hindering) the emergence and development of the governance innovations in focus. The list of questions is structured along the seven system dimensions identified in the literature review, and shall be seen as an additional information mean – together with other insights on actors, institutional and biophysical context conditions from other WPs- to gain a comprehensive picture of the innovation situation in the various case study regions.

1 Introduction

The analysis framework for the governance of policy and business innovation types and conditions is developed in the context of the H2020 InnoForESt Innovation Action as an analytical lens to explore influencing factors of governance innovation types and conditions for the sustainable provision of forest ecosystem services. Building on the idea to analyse InnoForESt case study innovations as interconnected social-ecological forestry systems, socio-technical systems, and innovation systems, the analysis framework shall support project partners and political decision-makers:

a) Retrospectively, to gain a good understanding of the emergence and development of forest governance innovations (i.e., what factors have influenced the innovation, from early ideas of its emergence and its developments until now); and

b) Prospectively, on the enabling conditions of their upscaling and upgrading potentials (i.e., what influence is needed for a similar innovation elsewhere, or an improved version of the innovation in the current context; how to reduce risks for failure).

The application of the analysis framework and the identification of innovation factors will support the InnoForESt partners from science and practice to streamline their activities and to speak the same language when thinking about innovation system dimensions and its influences. Participating scientists from different disciplines and work packages, and the range of practice partners from forest policy, management and business have different understandings of terms and conditions for governance innovations to work. The common analysis framework supports collecting information on innovation systems in a comparable way by analysing, diagnosing, explaining and predicting system dimensions, influencing factors, degree and influence direction, outcomes and requirements for governance innovations to emerge, develop and work in an intended way. These insights are one basis for fostering and improving governance innovations, and respective policy and business recommendations that shall create enabling conditions for the sustainable provision of forest ecosystem services.

The analysis framework therefore eases the choice of system dimensions and potentially influencing factors to be analysed, with the respective freedom of individual adjustments to their corresponding case study contexts. The framework contains biophysical, institutional and technical forestry systems dimension as universal elements that any theory relevant to the same kind of phenomenon would need to include (McGinnis, 2014). The framework identifies and explains those system dimensions and their respective set of factors that may have an influence (positive or negative) for the innovation to emerge, develop and unfold. It demonstrates the connection and interrelation between these crucial factors and system dimensions in a holistic way (McGinnis, 2014).

The development of the analysis framework builds on the idea of complex processes within linked *social-ecological-technical-forestry-innovation systems* (*SETFIS*). The SETFIS is characterised by seven system dimensions: Actors, institutions, biophysical conditions, forest management, innovation, external influences and governance of innovation. Governance innovations in the context of InnoForESt are defined as new actor alliances/networks as well as payment schemes, but may also refer to hybrids, new policy mixes, processes and novel forms of organisation.

To describe the various system dimensions, related factors and their interlinkages, we draw on a set of theories and concepts from social-ecological research, sustainability sciences, institutional economics, innovation studies and political science, as a basis for developing the analysis framework.

The interdisciplinary nature of the analysis framework supports comparative analysis over a range of different case study conditions and innovation types while acknowledging the complexity of forestry innovation systems in different contexts.

This document is structured in five sections. After the introduction, section 2 details the methodological proceeding for conceptualising the analysis framework. Section 3 focuses on theories and concepts for the identification of system dimensions and influencing factors, as the main conceptual basis for the analysis framework. These support the recognition of how to change, adapt and create policies and management systems, get key stakeholders on-board, or optimize processes of institutional evolution for creating– or transforming towards, an innovation-friendly environment. Section 5 provides a synthesis of the analysis framework in form of a table and graphics, including an explanation part. It presents the identified system dimensions and factors, and shows synergies with related activities from WP2, WP4 and WP5. All information about InnoForESt governance innovations is elaborated in a complementary way by the different work packages and for different contexts, dimensions and levels. Section 6 section suggests practical ways to apply the analysis framework in Innovation Region contexts and use its findings, i.e. in experiments for prototype development (WP3.2/3.3) and for innovation activities in case study areas (WP4, WP5) by providing a list of supporting questions and broad-spectrum recommendations. Concretely, the framework can be used to:

a) Manage governance innovation complexity by pre-sorting potential system dimensions and influencing factors for empirical validation;

b) As a communication tool that stimulates thinking about further influences that are so far left out of the conceptual scope.

As such, the analysis framework is the starting point for better understanding of forestry innovation system conditions for innovation action. Theories help sorting relevant factors within the framework that are necessary for the emergence and development of innovations. Furthermore, the theories assist to understand how these factors are shaping the innovation and vice versa. This will help to analyse innovation development, explain their dynamics, and suggest ways for modification that can improve their upgrading and upscaling potentials and the creation of an innovation-friendly environment in case study regions and beyond.

2 Methodology

Deliverable 3.1 presents system dimensions and sets of factors for the analysis of governance innovations in different case study contexts. The analysis framework departs from an initial set of conceptual approaches for explaining complex social-ecological, technical and innovation systems. Through a literature review, the most relevant systems and innovation theories and concepts were identified, using ISI Web of Science; Google Scholar; Livivo; EcoBiz; ScienceDirect; OECD Library, IFAF Berlin and EBSCO as search engines.

We conducted an extensive literature research of primary and secondary literature to understand and describe complex social-ecological-technical forestry systems and the principles of governance innovations. Key concepts included are:

- Socio-Ecological Systems (SES);
- Environmental Governance and Polycentric Approach;
- Socio-Technical Systems (STS);
- Forest Management Systems (FMS); and
- Innovation Systems (IS).

We describe each concept in detail, main assumptions and findings from former applications, and the system dimensions and its related factors that is included in the analysis framework. We further add a process dimension to the framework and introduces methodologies for actively inducing change:

- Ideas of Governance of Change;
- Transition Management; and
- Foresight and Scenario Approaches.

In a second phase, through an iterative consultation process, the analytical framework was and will be further extended and adapted, according to new insights originate from case study contexts and related WP activities. Related activities include work conducted by WP2 (institutional and biophysical mapping), WP3.2 and 3.3 (factor re-configuration and prototype development), WP4 (matching tool) and WP5 (CINA workshops) to proof and identify new dimensions and influencing factors, as well as their interconnections. As such, the analysis of influencing factors for governance innovation is based on a series of iterative activities and interplays with case study contexts research and innovation activities. Feedback loops within and among the various tasks and activities, will improve the analysis framework continuously. This interplay between cases and WPs, and the iterative process, secures the level of quality, co-checking of results and consistency during the entire project.

3 Conceptual Basis for the Analysis Framework

Various theories and concepts in the realm of social-ecological systems research, sustainability sciences, and transition research describe the complexity of complex and linked system dimensions, their interactions and impacts. Examples of systems-oriented frameworks include the Institutional Analysis and Development Approach (IAD), Social-Ecological Systems framework (SES) (McGinnis & Ostrom, 2014; Ostrom, 2011), International Environmental Regimes Approach (IER), Transaction Cost Economics (TCE), Institutions of Sustainability (IoS), Adaptive Systems Heuristics (ASH) (Hagedorn, 2013), Socio-Technical Systems (STS), Socio-Technical-Innovation Systems (STIS) or Adaptive Governance (Gunderson, 2002; March, 1983), policy networks, governance, reflexivity and accountability (Rhodes, 1997), and Multi-Level Governance (Jordan, 2001). In addition, concepts with direct relevance to ecosystem services, address the governance of ecosystem services (Primmer, 2015), including multiple-levels, multi actors and multi rationalities (Loft et al., 2015).

Selecting the appropriate framework in InnoForESt to describe governance innovations for forest ecosystem service provision, was done according to following selection criteria: The framework needs to provide a model to conceptualize biophysical and social systems. It is considered necessary that the framework not only combines the ecological and social environment, but, at the same time, accounts also the dynamics between the system dimensions and their interactions. The Social-Ecological Systems framework (SES) is chosen to serve as a conceptual basis for the development of the InnoForESt analysis framework, providing a common language and including variables that can be observed and compared across case study regions (Binder, 2013). In the course of framework development, four further concepts are integrated that allow for a more complete analysis of forestry innovation systems. Following, the five key concepts are described in detail and relevant system dimensions and factors extracted according to the structure below:

Structure of the theoretical orientation:

The following overview provides an explanation how the review of each concept is structured:

Aim – Why is this specific concept/theory useful for system innovation analysis?

Elaboration – What is the concept/theory about? What is the purpose of the concept/theory in relation to InnoForESt**,** including potentials, challenges, specific assumptions and characteristics?

Outcome – Which dimension/factor from this concept/theory is useful for the "structure" of the analysis framework and why? What influence and interrelation to other dimensions/factors exist, and how can this be interpreted, analysed and evaluated?

A quick **overview** of system dimensions, factors and factor subgroup (including examples) that are used for the analysis framework is provided in form of an overview table. Some of the factors appear in various concepts and theories, and are therefore shown in only one table.

3.1 Social-Ecological Systems Framework (SES)

The SES framework provides a common language to understand multi-level systems, especially social and ecological systems, in order to comprehend their conceptualization, dynamics, interactions and interrelation. It comprises variables for cross case-study comparison with a focus on biophysical, social/institutional interactions with regard to governance innovation processes.

Aim:

The Socio-Ecological System framework (SES) elaborated by Elinor Ostrom and colleagues (McGinnis & Ostrom, 2014; Ostrom, 2011) serves as the overall conceptual basis for this analytical framework. It builds on the Institutional Analysis and Development Approach (IAD), which describes the social and ecological components of coupled social-ecological systems, their interlinkages and feedbacks. Advantages of the SES framework are that it has proven its existence in many empirical applications (Lara Rivero, 2014; Schlüter, 2014), provides the possibility for adaptation and a common language (McGinnis, 2014) that help a common understanding among heterogeneous stakeholders. The framework highlights the independencies of geographic regions, ecosystems, actors and policy settings in a multi-dimensional way. It aids gaining a system-based understanding of action situations with help of extensive sets of multi-dimensional factors, and its interdisciplinary character, utilising natural and social sciences disciplines and concepts. Therefore, the framework draws attention to social and ecological system dimensions and factors that support the understanding of innovation development, with a strong emphasis on environmental governance systems.

Elaboration:

With help of the SES framework, action arenas and their dynamics can be explored. Action arenas refer for example to situations where governance innovations emerge, develop and coordinate, in which actors are interacting and are affected by external influences, such as biophysical conditions, particular characteristics of communities, and by institutions as the formal and informal rules-in-use (Ostrom, 2011). Generally, the SES framework closely connects social systems (i.e. the governance systems and actors) and biophysical systems (resource system and resource units) (Figure 1). The main dimensions of the SES framework are actors, governance system, ecosystem structure, ecosystem units, social-economic-political setting and related ecosystems. The latter two can be seen as external influences, while action situation, the last main dimension, is centred in between the other four dimensions. In the following, the different dimensions of the SES framework are explained.

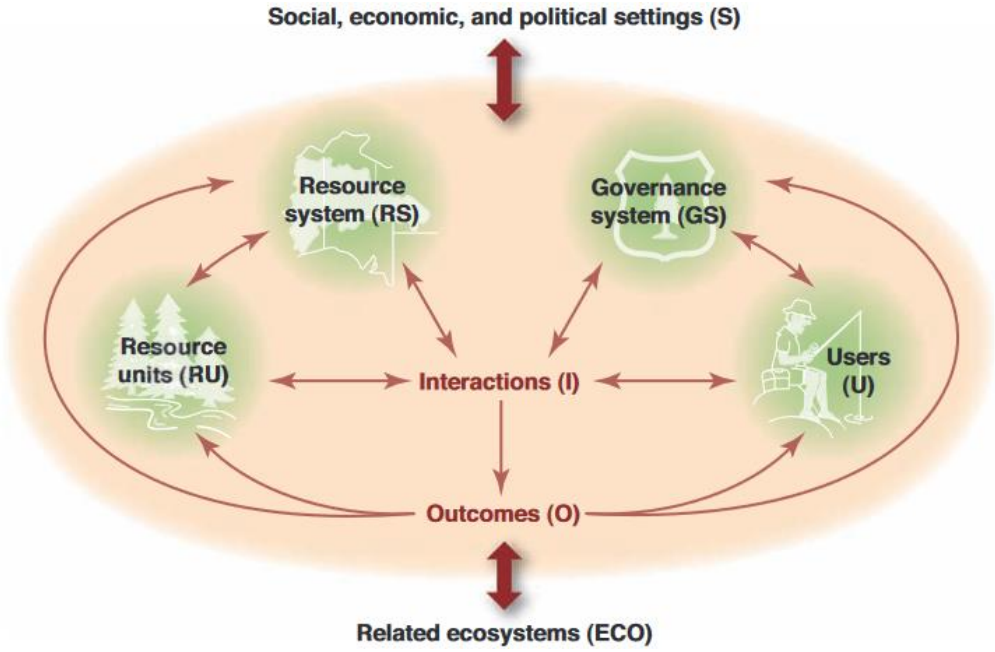

FIGURE 1 THE SES FRAMEWORK (OSTROM, 2009)

Biophysical system, provides insights to the interaction between the biophysical dimension, specified as resource system and units, and the governance system and users, how they relate to-, and influence each other. Ostrom distinguishes between resource systems and units (McGinnis, 2014). The resource unit, compared to resource systems in SES has a focus on local level (Hagedorn, 2008), including a larger view on governance system and the broader context of the environment. Those two dimensions, resource system and resource units will be combined in InnoForESt to biophysical systems in order to describe forest structures and ecosystem processes (resource system) and forest ecosystem services (resource units). Indeed, ecosystem governance relates directly to ecosystem structures and functions, as well as the services and benefits derived from them and the values attributed to the benefits (Primmer et al., 2015).

In InnoForESt, results from biophysical and institutional mapping in WP 2 in combination with the analysis framework application will lead to further insights about the biophysical dynamics for forest ecosystem service provision, and interactions the socio-institutional environment within forests.

Actors, individuals or groups, use different behaviour in order to reach their goal under specific circumstances, which include access to information, knowledge on processes, their position within particular contexts, calculated benefits and costs, participation in organisations, etc. These factors need to be analysed in order to provide future predictions of their action behaviour (Ostrom, 2011), and therefore of certain developments, such as innovations. Furthermore, it important to analyse actors in relation to the individual outcome of their actions within the context of the innovation, as actors may have different property rights, benefit more than others or have more power in negotiations due to possible underrepresentation. Actors can be seen as fallible learners that are learning from their failures, using their historical experience for future individual predictions of their costs and benefits. Institutions around them can ease or block learning effects of actors and therefore they are important to provide or even shorten those types of feedback loops, which needs to be analysed in the later analysis. Actors have specific needs and want to reach their goals through action/interaction with other actors under specific circumstances (external and internal possibilities and limitations) (McGinnis, 2014). Their behaviour can be analysed and directed to certain variables, understood as influencing factors in the context of InnoForESt.

The analysis of policies in use, historical events, particular actor constellations, power relations and interactions that are or may be related to ecosystem service provision and the governance innovation in focus are examples of factors in this system dimension.

Moreover, the interests, motives and needs of actors are another important characteristic to be elaborated, which might have an important influence on governance innovations. The framework does not predefine which actors/actor groups need to be analysed, but selection shall be oriented towards the respective question/problem at stake (McGinnis, 2014). Ostrom (2014) further mentions that the actors are free to create their own rules within (the given framework of constitutional rules within) the governance system.

Governance System, as another central element of Ostrom's SES framework will be described in detail in section 3.2 "Environmental governance, institutions, and polycentric approaches".

Action Situation. An action situation is characterised by biophysical systems dimension (resource systems and units), and the governance systems and actors dimension, including their interactions that produce particular outcomes (Ostrom, 2011). The different system dimensions and the related sets of factors frame/influence the action situation. In InnoForESt, the action situation is defined by the governance innovation in focus, and system interactions include for example communication and exchange between stakeholders, certain policies, habits and traditions in place, forest types and ecosystem services provided.

The action situations need to be analysed in its different parts, in order to understand the dynamics of the SES, especially the dynamics on innovation processes. Important for the action situations are different characteristics, as the frequency of its occurrence (unique, frequently, indefinitely), specifications, predictability and irreversibility (Hagedorn, 2013). In addition, the communication between the actors needs to be understood (Hagedorn, 2013), especially when it comes to the enabling of innovation or mutual learning. Consequently, action situations are inherently characterised by networking and communication processes that influence governance innovation processes.

One of the outcomes of action situations are direct feedbacks to the SES, because, for example, business and policy innovations may redefine and reorganize actor rights to ecosystem services, access and use related to the respective SETFIS. This creates new rights, responsibilities of managing and governing FES, namely new institutions. New or adapted policies, actors and management regimes affect the business and policy innovations where the "innovation process circle" started, which includes a feedback and learning cycle of different sizes. A new outcome could be, for example, the involvement of another actor that has not participated in previous stages of the innovation, a new way of cooperation, or a new market opportunity. Therefore, the governance innovation process/situation depends on the innovation capacity of the governance system and the mix of private and public actors acting in the selected system where the innovations (may) occur.

External Influences

A wider embeddedness of social-ecological systems is considered in the framework by including a set of external influences. Coupled social-ecological systems cannot be seen completely separated from surrounding ecosystems. To simplify the analysis and to make it possible to analyse local Socio-Ecological System, a cut is created between the focal system and external, but tele-coupled systems and certain events and trends as climate, demographic, economic or political changes/shocks. By including external influences, uncertainty decreases by having in mind certain factors, events and dynamics that influence the innovation from the outside of the focal SES, positive or negative.

Outcome:

SES provides a basic structure for the InnoForESt analysis framework in form of two central system dimensions: biophysical dimension and governance dimension. Resource system and resource units are subsumed into the category "Biophysical conditions" as one system dimension. Adjusting it to the context of the InnoForESt project, biophysical conditions is subdivided into ecosystem structure and ecosystem services.

Actors (users) and institutions are combined under the dimension governance system. Actors include individuals and organizations related to governance innovations within their respective governance system. Actors therefore focus on "who" influences innovation processes, and governance systems on "how" are actors and therefore an innovation process itself affected by their institutions. This also helps to distinguish easier between institutions (rules, laws, norms) and organizations (actors as NGOs, PPP, networks etc.). Governance Innovation processes for ecosystem service provision is the action situation and the central focus of the analysis framework.

Summarizing, based on the conceptual insight of Ostrom's SES framework, the following outcome will be included to the analysis framework (Table 2). The table is categorized into three dimensions, and its related factors and factor subgroups. Please note that details on the governance dimension are explained in detail in section 3.2 on environmental governance and polycentric approaches.

TABLE 1 FACTOR SUMMARY OF SOCIAL-ECOLOGICAL SYSTEMS (SES)

Dimension	Factor	Factor Subgroup/ Examples
Actors (Governance System)		
	Types	Public, public-private, private
	Socioeconomic attributes	
	Roles and rights	Property rights, ownership
	Relation to ES	Beneficiary, Provider/dependency
	Collaboration	Networks (adaptive networks)
	Information	Access, sharing
	Conflict resolution	Winner/looser
	Relationships, power relations	
Biophysical Conditions		
	Ecosystem services	Supporting, provisioning, regulating, cultural
	Ecosystem structure	Clarity of system boundaries, size of resource system, predictability of system dynamics, interaction among resource units, economic value, number of units, distinctive characteristics, spatial & temporal distribution
External influences from Larger Context		
	Related ecosystems	Climate and pollution patterns
	Social, political, economical	Political stability, other governance systems, markets, economic development, technology, demographic trends, media organizations

3.2 Environmental Governance, Institutions and Polycentric Approaches

Environmental governance, institutions and polycentric approaches refer to social system structures, sets of rules and the central coordination mechanisms actors align with/refer to when providing and using ecosystem goods and services. Centrally, governance systems are characterised by the formal and informal rules in use, such as policies, property rights, norms and traditions, organising the interface between society and its natural resource basis. Understanding coordination structures and institutions is central for creating novel or adapting governance innovations for the sustainable provision of forest ecosystem service.

Aim:

The concept of environmental governance, institutions and polycentric approaches are widely used to frame and justify environmental policymaking. Emerging conjointly with the concept of sustainability, environmental governance is understood as a mode of societal coordination (Kemp, 2005) that recognizes the role of both institutions and collective action (Hodge, 2007). In a purposeful contrast to the traditional understanding of coordination by a central government, governance refers to decision-making processes by which the use of common goods and services are decided upon by a wider range of stakeholders and societal actors operating not only aside, but often in collaboration with the state (Rival, 2013). Governance structures organise processes, determine objectives, set standards, influence motivations, initiate or reduce conflicts and resolve disputes among actors (Eden, 1997). According to Ostrom and Basurto (2011), their effectiveness depends largely on the rules they rely upon as well as their enforcement.

Empirical evidence suggests that most ecosystem services as common-pool-resources are neither best governed by the state on behalf of the people nor by non-state actors and markets (Rival, 2013). Indeed, the notion of governance is extended to cooperation between the state, as a central actor with a major role in discourses on sustainability (Kemp, 2005), and non-state actors that may have been previously excluded from the policy process. In particular the latter may be involved more directly in public decision-making (Windhoff-Héritier, 1987). This framing of governance of common environmental goods and services in the context of uncertain and complex action situations serves as a basic perspective in the InnoForESt framework.

Institutions

Governance structures foster particular institutions for human action. Following a neo-institutional and policy sciences understanding, institutions are constellations of formal and informal rules that guide social practices, define roles and interactions among those who participate in them (Bromley, 1992; North, 1991; Schlager, 1992; Young, 1996). They can be hierarchical ('command-and-control' dominating types of coordination), or non-hierarchical, based on market mechanisms (prices, competition) or cooperative arrangements and networks where social relations centrally rely on trust. Institutions organise the interface between social and ecological systems by regulating resource use, overuse and other types of human impacts such as pollution (Young, 2002). While these ideal-types structures and coordination mechanisms in their pure form hardly exist in reality, recent governance research highlights their hybrid, multilevel, and cross-sectoral nature for decision-making and collective action (Loft et al., 2015; Rival, 2013).

Policy instruments, similar to property rights and contract laws (Williamson, 2005), are one form –or subset– of formal rules that coordinate the ways in which actors actually, or are expected to, behave. They do so by establishing opportunities and constraints, privileging certain interests and excluding others, and thereby following a defined logic of problem definition and solution (Lascoumes, 2007). Policies are classified as either regulatory or command-and-control instruments, economic instruments or advisory/voluntary instruments (Scott, 2008).

Policy instruments are further distinguished into hard regulations, i.e. as legally binding rules which are enforceable by state authority (Borrás, 2014), and soft regulation. The latter refers to normative and cognitive rules, reflecting the roles and values by which actors make sense of the world, and the degree to which goals are shared. Appropriate institutions will increase the likelihood of achieving policy objectives, i.e. they increase the degree of sustainable compliance of the actors, as well as an (intended) change of behaviour at reasonable cost (Bickers, 2001; Rutherford, 2001).

Linking this conceptual orientation to the InnoForESt objective to analyse governance innovations for forest ecosystem service provision underlines the necessity to understand the institutions in place. This includes formal and informal institutions, but also the rulemaking organisations, stakeholders concerned, opportunities for collaboration between and within different agencies, across levels, sectors and actors as well as path dependencies and power structures that influences the processes of creating or adaptation institutions (Ban, 2013). New governance arrangements should build on earlier processes and existing institutions, fit local context conditions, and acknowledging the actors involved and impacted (Ostrom, 2011; Persha, 2011). For sustainable forest ecosystem service governance in InnoForESt, it is thus essential to reach shared agreement on an appropriate structure of rights, rules, roles, and decision-making processes (Hajer, 2015; Loft et al., 2015; Young, 2008).

With a focus on institutional interplay, special attention needs to be paid to policy coherence. In addition to forest policy, a consideration of climate, environmental, agricultural policies, but also social policy is necessary in order to address problem of FES provision correctly and to provide pathways for further innovation development.

Facing the challenge of institutional interplay, and balancing interests of multiple actors in multiple levels and sectors calls for exchange processes for negotiating and balancing the various interests involved (Nagendra, 2012). In this regard Jordan and Turnpenny (2008) suggest the establishment of dedicated policy formation venues as "institutional locations, both within and outside governmental settings, in which policy formulation tasks are performed, with the aim of informing the design, content, and effects of policy making activities" (Jordan, 2014). The innovation platforms of InnoForESt in each case study region are intended to function as such type of venues and will be implemented at a later stage of the InnoForESt project.

Polycentric Approach

As most forest ecosystem services have the character of public good/global common pool resources (Ostrom, 2011; Paavola, 2011), demand and solutions for their sustainable provision occurs on both global and local levels. To manage this multi-level environment of actors, often combinations of hierarchical top-down and bottom-up solutions are required as hybrids. A successful operation of those hybrid and polycentric types of governance requires tremendous communication, a certain coordination in terms of common goals and freedom to act independent in their respective focus area. Characterised by voluntary membership of polycentric governance, a higher occurrence of governance innovations exists within those systems (Kern, 2009).

More precisely, adaptive co-management (Armitage, 2009; Olsson, 2004) is characterised by combining learning with the use of existing structures and flexibility via adaptive management (Gunderson, 2002). Co-management (Yaffee, 2000) on the other hand contains the multi-level and multi-sector sphere of power, rights and responsibilities between the society and the state (Huitema, 2009). Literature from adaptive co-management recommends therefore multiple centres of decision-making, management and power (Huitema, 2009; Skelcher, 2005). Multiple centres of organisation can increase the level of legitimacy, which is often an important reason for turning to polycentric approaches in first place. Polycentric governance approaches are considered a useful orientation for the sustainable provision of the range of forest ecosystem services as they concentrate on dynamic and complex systems governed by multiple centres of independent authorities (Ostrom et al., 1961).

This approach helps to identify multi-level and multi-sector responsibilities for the management and use of natural resources in order to secure the sustainability of focal SES. In particular, networks are promising approaches in this regard as they may equal power relations between actors, reduce the lobbying power of certain actor groups, and therefore improve the sustainability of innovation processes. Those types of self-organized institutions may support the innovation process, and are in focus of the InnoForESt project as case study innovations.

Outcome:

Insights from environmental governance, institutions and polycentric approaches help concretising the governance system dimension, including institutions and actors. Derived factors include formal rules, informal rules, different types of policy instruments, access of actors to decision-making, cross-level communication, cross-sector coordination, distributed power and rights, especially property rights. Furthermore, trust in order to share information and the capability to learn (Primmer, 2015) and to adapt rules, because those factors are important for creating and fulfilling rules that are characterizing the innovation system and therefore its further development. These factors are context related and therefore important to be looked at in the case studies (Castillo, 2011).

Being aware of the need for capacity building, InnoForESt establishes innovation platforms as a mean for actor exchange, improving institutional interplay and network formation. Largely, they serve as central knowledge exchange hubs for the multi-actors of the focal system.

In such hybrid settings, the establishment and improvement of governance innovation can be supported by heterogeneous science and practice partners to develop accepted and sustainable solutions for FES provision and to meet local, national and international policy requirements in a sound way.

Based on the conceptual insight from environmental governance, institutions and polycentric approaches, the following dimensions and factors are included into the analysis framework (Table 2).

TABLE 2 FACTOR SUMMARY OF ENVIRONMENTAL GOVERNANCE AND POLYCENTRIC APPROACH

Dimension	Factor	Factor Subgroup/ Examples
Institutions (Governance System)		
	Institutional interplay	
	Regulation	
	Hierarchy	Formal institutions (hard regulation), (laws, command-and-control policies, statutes, property rights) Formal institutions (soft regulation), (Information/advisory instruments (guidelines, information technology and platforms, extension and advice) Informal rules (traditions, habits, norms, trust)
	Markets	Market-based instruments (taxes)
		Voluntary markets (trading systems, payment schemes)
		Private-to-private (+with intermediaries)
		Market-like arrangements organized by government (e.g. conservation tenders)
	Polycentric Approach	Distributed authority
	Networks (self-organised)	Public-public, public-private, private-private, polycentric/hybrids (cooperatives)
	Policy Instruments (Support by Government)	Incentives (compensation), Subsidies, R&D policies (financial support for science), Patents, technology, niche support, networking support laws, possibilities of access)
		Information/advisory instruments
Actors (Governance System)		
	Participation	Inclusion, exclusion, representation/underrepresentation
	Acceptance & legitimacy	
	Lobbying	Power
	Knowledge of SES	

3.3 Socio-Technical Systems

Adding insights from Socio-Technical-Systems (STS) research to the InnoForESt analysis framework adds a view on system dimensions of social-ecological and technical systems, i.e. to the understanding of innovation dynamics and interrelations between novel developments (the ‘niche’ dimensions), mainstreaming (the ‘regime’ dimension) and exogenous influences (the ‘landscape’ dimension), as well as on the related roles of actors.

Aim:

Ostrom mentions the possibility to integrate Socio-Technical System (STS) into the SES framework, as humans are active in every ecosystem and all technologies are dependent on ecosystems (McGinnis, 2014). In case of InnoForESt, the Forest Management System (FMS) is partly understood as a socio-technical system as it provides certain infrastructures, operations and innovation enabling/hindering conditions. (Please note: Differences in forest management strategies will be explained separately in the following chapter.) Adding a technological dimension and its potential influencing factors on governance innovation process help gaining a more comprehensive picture in case study regions.

Elaboration:

Socio-Technical-Systems (STS) are ensembles of socio-technical elements such as infrastructure, technical artefacts, ownership and corporate structures, financial and/or insurance institutions, that interact with each other in distinct ways, are distinguishable from their environment, and are specific forms of collective knowledge production and utilization in the society. The technical elements are created, implemented and shaped by actors like governmental bodies/agencies, research institutes, universities and consumers. In general, all actors that influence directly the way how society or governance innovation processes are organized, including creating, using and sharing knowledge and infrastructures (Borrás, 2012).

An important concept that originates in STS research on innovation emergence, development and impacts is the Multi-level perspective by Geels and Schot (2007) and Rip and Kemp (1998), as presented in Figure 2. The concept is not limited to technological innovation, but considers socio-economic innovation processes in general (Witkamp, 2011) from an integrated historical, evolutionary economics, science and technology studies and policy studies perspective. The heuristic approach explains that the transition of innovation development happens in three central und functional independent dimensions (Rip, 2012, 1998). They address different "degrees of structuration of local practice", scales and numbers of actors reproducing regimes and niches, degrees of stability, but not necessarily of hierarchy (Geels, 2011), as well as different ways in which "the context influences the dynamics of innovation journeys" (Rip, 2012). Those dimensions are (1) niches as protected spaces, (2) regimes as sets of rules, practices, and routines for developing an incumbent technology or governance further and (3) landscapes that provide "a backdrop of opportunities and constraints" (Rip, 2012). They are continuously interacting, albeit with different magnitude. Innovations are created within niches, which consist of individual and collective actors, technologies and routines. Actors may have the role of innovation pioneers, enablers or selectors, who push the development and diffusion of the innovation forward, but may also act as blockage. Emerging routines and rules stabilise novelty in niches. Upon maturation, niche innovation may in some way or another link into the incumbent regime, sometimes even reconfiguring it or substituting existing elements. The regime dimension is characterized by existent formal (laws, regulations), informal (norms, traditions) and cognitive (visions, problem/solution definition) patterns, which are formed by the main actors within this system. This can be seen as the centre of power (Schneidewind, 2012) and present dominant structures, routines, cultures, and conventions. The landscape dimension includes exogenous factors that cannot be influenced directly, as environmental and social problems, e.g. climate change, poverty, trends, international institutions and organisations. At the same time, landscape developments may orientate or influence regime and niche more or less directly (think of shock events, or powerful new trends changing the broader condition of the possibility of regime and niche activity and structure). An example is supporting and investment measures/plans for specific innovations. Here, actors can, follow their vision, view and beliefs, which are not directly shared in the regime in general (Konrad, 2006). On the other hand, can exogenous pressures on landscape level can open windows of opportunities for novelties.

Less often addressed are the destabilisation of existing system properties, which may even become misaligned through active effort of discontinuation governance (e.g., divestment from fossils, nuclear exit, DDT ban; cf. Stegmaier, 2014, 2012).

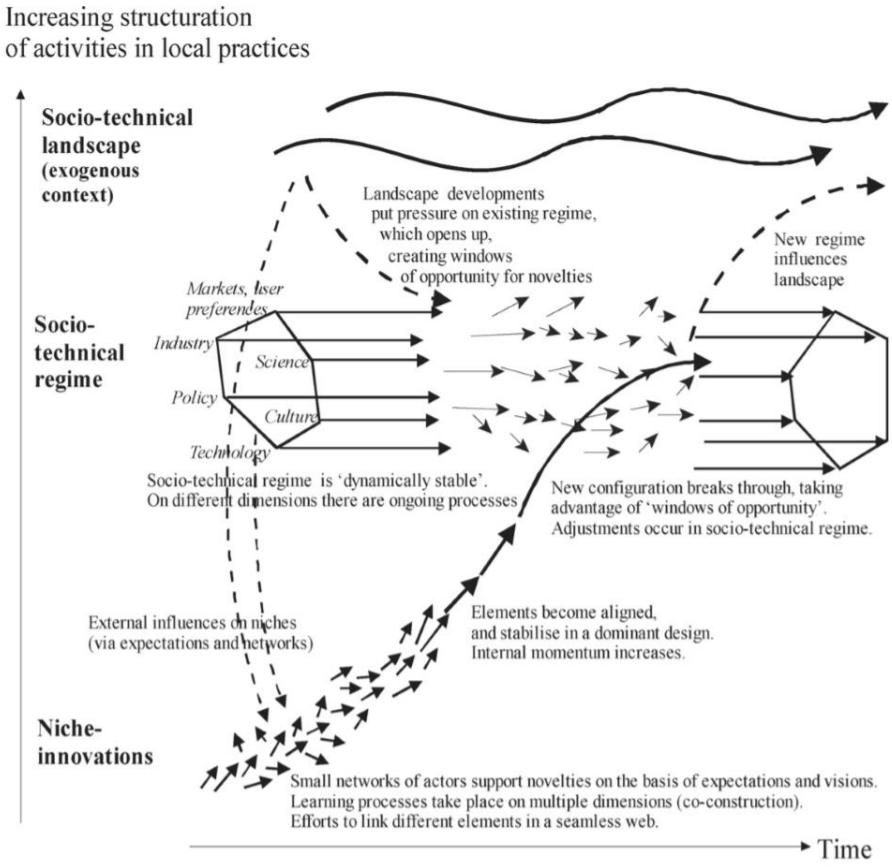

FIGURE 2 MLP – THE MULTI-LEVEL PERSPECTIVE (GEELS, SCHOTT 2007)

Outcome:

The integration of the STS into the InnoForESt analysis framework allows to add a new perspective on innovation establishment, i.e., a distinction into STS dimensions, in particular regarding the niches for innovation establishment and test, as well as further distinctions of actors into innovation pioneers, enablers, and change agents. The dynamic aspect is emphasised. Table 3, summarizes the factors included from STS into the analysis framework.

TABLE 3 FACTOR SUMMARY OF SOCIO-TECHNICAL SYSTEMS (STS)

Dimension	Factor	Factor Subgroup/ Examples
Innovation System		
	Niche, regime, landscape developments	Dimensions of innovation context conditions
Actors (Governance System)		
	Categorization of actors (According to their area of action and influence)	Innovation pioneers, enablers, selectors change agents, Macro-, meso-, micro-actors (vertical vs. horizontal)
	Type of Ownership	

3.4 Forest Management Systems

Forest Management Systems are a further part of STS, which helps to understand the relationship between the technological sphere of forest management on governance innovations for forest ecosystem service provision, such as particular needs/requirements for infrastructures, forestry operations, technological devices etc.

Aim:

As another part of STS, forest management systems and practices are in focus of the InnoForESt project. Forest management operations are based on, and form a technical system that provides certain infrastructures, harvesting methods and technologies such as machinery, skills etc. that might be vital for the governance innovation for forest ecosystem service provision. For the analysis framework, this technological forest management system is to be included as a dimension, that is closely related to social/institutional dimensions and the ecological (forest ecosystem) dimensions. This new dimension includes particular management characteristics and its effects. FMS can be explained by certain forest management objectives and basic principles, which may affect governance innovations and development. Therefore, it is important to explain those factors and proof their relevancy in particular case study contexts.

Elaboration:

Forests are managed by humans in order to receive resources such as timber, fuel, construction material and food, besides others. Management intensity has been risen in the last centuries through demographic and economic drifts (Farrell, 2000; McGrath, 2015). Those changes, besides other global drivers, have led to various forest management systems. Forestry as science implies decisive manipulation of the forest characteristics and management processes. Certain settings of the forest management system are predetermined, e.g. biogeographically site factors, current tree composition, economic and market circumstances, whereas operational processes (site preparation, species selection, planting, etc.) can be controlled and transformed by the management of the forest. Therefore, the forest management system can have crucial impact on the short, medium and long-term development of the innovation. Consequently, forest management serves as a means for the development of a forest towards certain objectives, e.g. provision of certain ecosystem services.

Many different forest types and management strategies exist in Europe, as well as various dynamics of management impacts over space and time through cultural differences. Duncker describes five ideal-typical forest management approaches in order to compare European Forests (Duncker, 2012). The approaches are divided through its intensity scale, starting with passive to intensive: unmanaged forest nature reserve, close-to-nature forestry, combined objective forestry, intensive even-aged forestry and short rotation forestry (Duncker, 2012). Those five approaches do not have to be seen as fixed rules and mutually exclusive. They provide a specific set of basic principles that are the operational red line for the managers, but at the same time offer various options that permits a free development of the overall strategy and decision-making processes of management. Changes from one FMS to another are possible, but require certain transition periods and changes from more intense FMS to less intense one require more time, because natural regeneration requires more time than cultivation and planting of young trees (Duncker, 2012).

The objectives of forest management can impact the equilibrium between ecological, economic and social dimensions of overall sustainable development (Farrell, 2000). The choice of FMS may depend on entrepreneurial or technical capabilities (Primmer, 2009). Major decisions in forest management are for example naturalness of tree species composition, tree improvement, type of regeneration, successional elements, machine operation, soil cultivation, fertilization/liming, application of chemical agents, integration of nature protection, final harvest and main silvicultural system and maturity of the

forest. FMS were for a long time dominated by top-down decisions from forest authorities and forest owners but more and more decision-making is also influenced by public demands and the inclusion of stakeholders/interest groups (Farrell, 2000). Additionally, forest management is shaped by external influences like international policies and strategies, such as the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC), as well as by socio-economic trends e.g. for nature/ecotourism and bioeconomy.

As forest ecosystem services are becoming more and more prominent on various national and international policy agendas, alternative forest management objectives emerge such as for nature-based tourism and recreation, but also carbon storage and biodiversity conservation (Furman, 2015; Rudra, 2016).

An additional influential communication and marketing instrument for sustainable forest management are certificates such as the FSC or PEFC label. These labels are market mechanism that assess the quality of the management, production and provision of products and services according to specific set of environmental, economic, social and technical standards, containing aspects on social working conditions and the well-being of livelihoods related to the respective forest (Muthoo, 2012). Forest management strategies, practices, infrastructures and certification are considered important influences in InnoForESt for governance innovations, and are therefore included in the analysis framework to be investigated in the project.

Outcome:

FMS adds a new dimension to the analysis framework of InnoForESt. It contains factors from forest practice, the role of forestry administration and the dynamics of forest management induced by external influence such as international forest-relevant policies, strategies and trends to the framework.

TABLE 4 FACTOR SUMMARY OF FOREST MANAGEMENT SYSTEMS

Dimension	Factor	Factor Subgroup/ Examples
Forest Management System		
	Entrepreneurship capabilities/leadership	
	Technical competencies	
	Business model	Tourism, bioeconomy, food, wood, etc.
	Financing structure	
	Certification in use	FSC, PEFC, not implemented
	Forest Management System	Clear-cut Clear-cut with retention trees Clear-cut with retention habitats Continuous cover forestry / selective, single-tree removals, coppice, close-to-nature management, afforestation (new plantations, e.g. on former agricultural land), agro-forestry (e.g. wood pastures and shelter trees)
	Technology	Technology available, technical support
	Impacts	
	Unintended FMS	
	Transferability	
	Local, regional, national, European, international/UN	
Actors (Governance System)		
	Level of adaptation, resilience	Continuity, changes

3.5 Innovation Systems

The last dimension added to the analysis framework of InnoForESt is Innovation Systems. This dimension and related factors provides a specific understanding of innovation types, dynamics and development stages that are necessary to understand the overall development and dynamics of governance innovations.

Aim:

Innovation systems are at the heart of the InnoForESt project and form the central focus of the analysis: Elaborating the governance innovation situation in the case study regions. Understanding how innovation systems are structured and functioning drives InnoForESt to develop a typology, and to identify development stages of governance innovations. Innovation systems include a similar focus as SES and STS, and are integrated into the analysis framework in an adapted way. Innovations exist of various dynamics, structures and developments that need to be disentangled and understood. The following part will look specifically on innovation types, stages and conditions for innovations.

Elaboration:

Generally, the innovation system concept sees the emergence, development and spread of innovations within a system as a structural context. Within this system, actors, institutions and interactions matter, as well as the history of the innovation development (its innovation journey). The focus on innovation systems in the context of this analysis framework are the innovation characteristics on the one hand, and on structural conditions, dynamics and its functions on the other to assess innovation performance. The structural dynamics/dimensions are, similar to SES, on actors, interactions, institutional setting, historical development, etc., to explain the successful diffusion or failure of an innovation.

Innovation Types

Innovations can be sorted into different innovation types. As many different categorisations exist, a self-created categorization is presented in Figure 3, comprising frequently used/mentioned versions of categorisation. Innovation types are product innovations, service innovations, process innovations, institutional-, policy-, cultural-, social-, and market innovation, besides innovative behaviour and reorganisation of an industry. InnoForESt mainly concentrates on institutional and policy innovations, subsumed as governance innovations in form of new actor alliances and networks as well as incentive-based mechanisms/payment schemes for financing forest ecosystem service provision. In addition, the framework is generally open towards the identification of connected product, service, process and *technological* innovation can be included a side, but will not be in the focus.

Innovation Types	*Institutional innovation*
	Policy and cultural innovation (e.g. Voß 2007)
	Innovative behaviour
	Market innovation (opening a new market, acquisition of market for new resources or unfinished products)
	Product innovation (OECD: product innovation)
	Process innovation (OECD: process innovation incl. facilities, management & organisational innovations)
	Service innovation (OECD)
	Social innovations (e.g. Zapf 1998; Howaldt & Jacobsen 2010; Kluvánková et al., 2018*)*
	Reorganisation of an industry

FIGURE 3 INNOVATION TYPES

Further, distinct levels of innovation analysis are distinguished into technology and sectoral; global, national, regional, local and individual level in order to analyse also the suitability of incentives for individual actors. The level of analysis will be supportive to categorize and assign specific characteristics of the analysis framework in terms of geographical diffusion, governance, actors, biophysical system and therefore for a better understanding of interrelations, e.g. EU and local governance influences on a regionally implemented innovation. Figure 4, shows a general overview of how regional innovation systems are embedded in national and global innovation systems, including actors and governance systems, other literature will talk about clusters (Asheim, 2011; Lee, 2010).

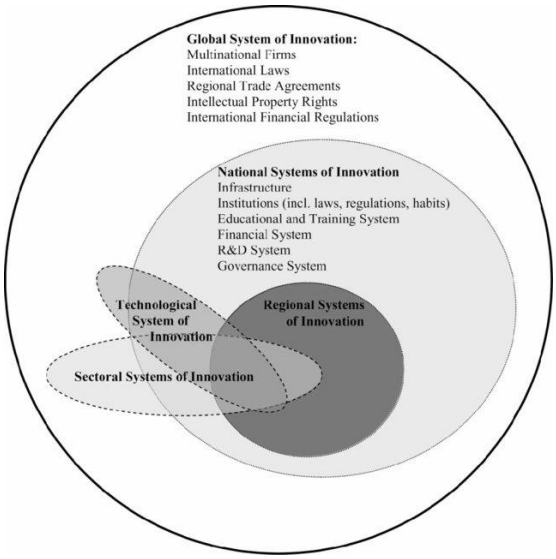

FIGURE 4 INNOVATION SYSTEMS

Innovation stages

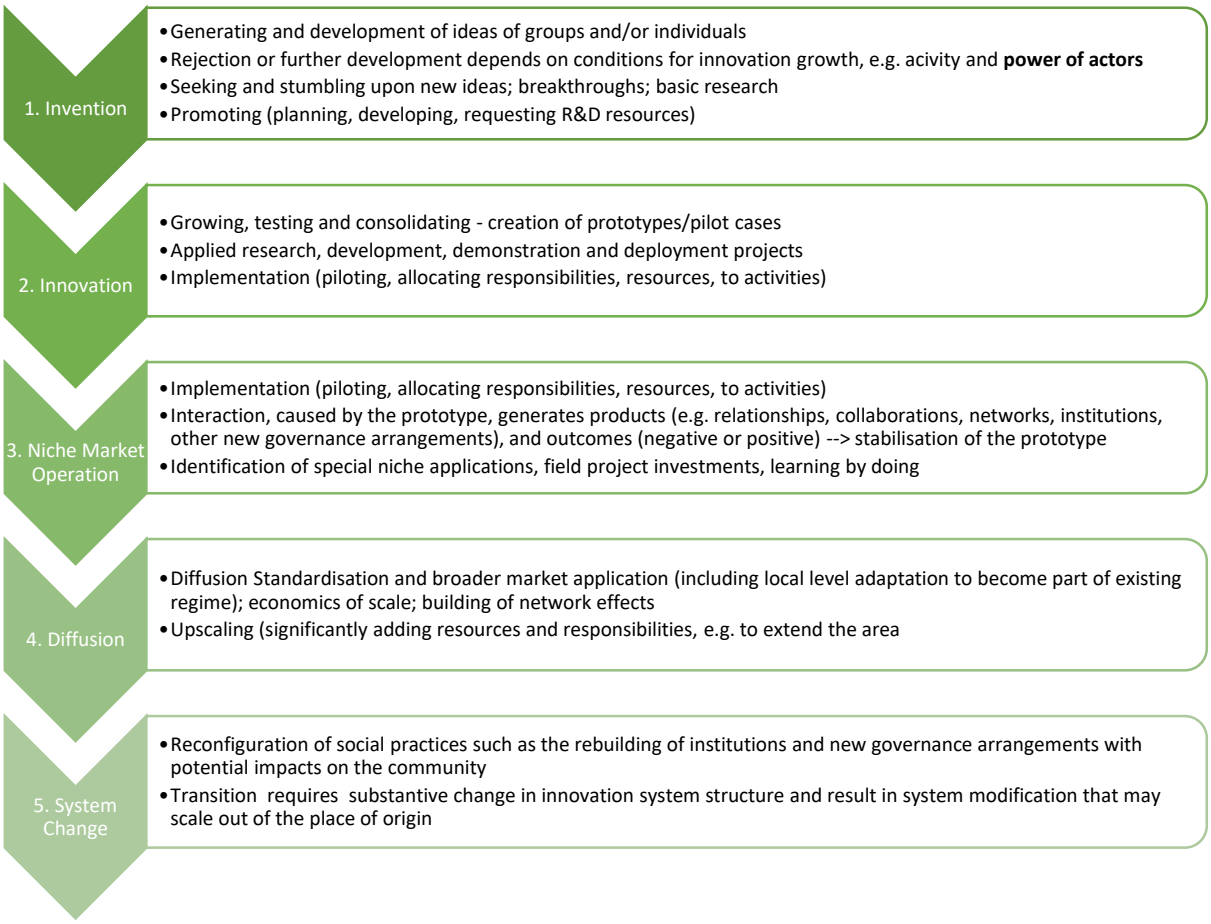

FIGURE 5 INNOVATION STAGES, SOURCE: OWN CREATION/COMBINATION: SIMRA - REFER TO KLUVÁNKOVA ET,AL 2017, KLUVÁNKOVÁ ET AL, IN PRESS; GRUBLER ET AL., 1999; CHRISTIANSEN, 2002

Different innovation stages can be additionally distinguished, from the generation of first ideas up to the reconfiguration of social practices (Figure 5). The six InnoForESt case study innovations are at different development stages, from the first stage (e.g. Italy) to the second (e.g. Austria) or third stage (e.g. Germany). Innovation development needs to be proper analysed and reconstructed to understand fostering and hindering factors and innovation system conditions to prepare the potential transfer into next development stages. The framework will provide useful insights into different processes that can be used as indications, e.g., for the creation of new institutions, involvement of new actors or specific historical events.

Innovation development is far most often not a linear process as their emergence and development is embodied in various complex and interlinked institutional and organisational processes, decision-making processes, and multi-actor and multi-level relations. Innovations are located in distinct environments and levels, and depend on the interaction of their actors, influenced by all dimensions, institutional setting, biophysical conditions, technical conditions, infrastructures etc. Their interrelations create all kinds of feedback loops between the elements of the innovation system (actors, institutions, technology). Therefore, it is necessary to understand the history of the innovation and allocate possible barriers for the future development of the innovation.

Interrelation and dynamics of Innovation

Innovations are often accompanied by other, related innovations. The concept of innovation relationships or clusters, a network of different, but connected innovations, states, that a required combination of circumstances and promoting innovations are necessary to secure a successful

implementation of a focal innovation (Voß, 2006). Also involved may be competing innovations, which have to be considered, if a wide spread diffusion of the innovation is desired. The concept also states that not always the "best innovation" finds its way to further diffusion. This concept includes some factors already mentioned by Ostrom, as networks and regulations, but shows that financing an innovation needs to be analysed as well, as it provides an inside to the structure of the administration/micro management of the innovation.

Barriers to Innovation

There are various types of barriers to innovations possible. Lock-in and path dependency are one form of barriers on the macro level, the general strategic sphere of the innovation development. Because an innovation depends on its path of development, such as initial markets, institutional and regulatory factors that are governing the implementation and development. This dependency can be stabilising and therefore supporting the innovation, but it also can lead to a lock-in of the innovation, because the required characteristics of the innovation systems, e.g. institutional setting and governmental incentives, are not existent (Dixit, 1994).

Also market failure can result from a barrier for the innovation. Market power and increasing returns are points to mention on the sectoral level and market failure on the micro level are split incentives, adverse selection, access to capital and transaction costs (Dixit, 1994).

Barriers can be created within firms, for example information deficiencies, bounded rationality, access to markets, the view on risk and uncertainty for planning or the appropriation of benefits. How do the forest owners decided under uncertainty and irreversibility (Dixit, 1994).

As mentioned, the path dependency within innovation systems can have positive effects as well, as Arthur (1994) mentions in the increasing returns to adoption, which included positive feedback, e.g. the more a technology is adopted, the more likely it is to be further adopted. This view is related to:

- Scale economies (declining unit costs)
- Learning effects (experience, learning by doing)
- Adaptive expectations (adoption reduces uncertainty)
- Network economics (the more users, the more useful)

Outcome:

Innovation systems feeds the analysis framework with a new dimension: A view on innovation types and dynamics. It comes with factors that help to better understand the development of the InnoForESt innovation cases until today and categorize specific characteristics of the innovation types and processes to get common and broad overview of the innovation from its emergence until now, as displayed in Table 5.

TABLE 5 FACTOR SUMMARY OF INNOVATION SYSTEMS

Dimension	Factor	Factor Subgroup/ Examples
Innovation System		
	Innovation type	Product, process, service, market, social innovation
	Development stage (time scale)	Invention, innovation, niche market operation, diffusion, system change
	Level of analysis	Local, regional, national, EU, European, International/global
	Development strategy	Open-ended or closed process
	Control systems	Monitoring and evaluation
	Barriers to the innovation	
	Sustainability of innovation	
	Improvement	Feedback loops
	Related innovations	Supporting Innovations, supplementing innovations, similar innovations, competing innovations,
	Spill-over effects	Positive/ negative
	Part of larger development	Megatrends, past events, social/historical pressure, etc.
Biophysical Conditions		
	Importance, involvement and impact of ES to innovation	

4 Innovation Process – Developing Pathways for Change

Social-Ecological-, Socio-Technical-, Forest Management and Innovation Systems are characterised by distinct system dimensions and factors as explained in the previous sections. Many processes, relations and dynamics of and between those system dimensions and factors create the environment (action situation) for the innovation development, including its adaptation and modification. Therefore, it is necessary to analyse those interrelations and provide possibilities for purposefully changing system conditions towards a more fostering environment. The following part takes on a prospective, future-oriented perspective, and looks at governance of change, transition management, foresight and scenarios approaches that add a process dimension to the analysis framework, helping future upgrading and upscaling activities in InnoForESt. Its structure follows a similar logic as the chapter before, including the aim, elaboration and outcome part of each method.

4.1 Governance of Change

Aim:

For fostering a more sustainable provision of forest ecosystem services, it is important to create an innovation-friendly environment. The concept of governance of change provides insights how to address change and to initiate intended transition processes more systematically. To create, spread and improve governance innovations, an understanding of the dynamics of SETFIS is important: Who and what is driving change, how can change be supported by diverse sets of actions and by different actors within their institutional settings, governance instruments, and how can legitimacy and acceptance be generated within SETFIS (Borras et al., 2012). Accordingly, governance of change can be understood as the mechanisms by which societal and state actors interact and coordinate in an intended way, to define processes and direction of innovation and change, and ideas how these are introduced, absorbed and diffused into society and economy (Borrás and Edler, 2012, 2014).

Elaboration:

Governance of change is related to intentional actions by actors that seek changes within the system through innovations, with a possible formation of a new system or a gradual transformation of the existing system. Governance innovations are meant to change the status-quo, and changes in or through the innovation are governed by various actors, institutions, cultural, technological and other factors. The boundaries of actions and responsibilities of governmental and non-state actors may become blurred due to collective action, as changes are driven by these actors within their respective areas of influence. Important for initiating changes is the creation of opportunity structures, of niches, as protected spaces for trying things out, for monitoring and learning.

These opportunity structures can be analysed through "possibilities" of participation, inclusion, as well as exclusion and underrepresentation of stakeholders/groups, and reflexivity within those processes and actions. How are strategies and abilities of state actors for example to design and implement participatory and open approaches that are supporting collective action for FES? Besides public-private or public-public networks, also scientific support can be actively fostered. E.g. science to innovation, supply and demand of innovation, as well as different actor arenas and institutional spaces can be created (Borras et al., 2012). Therefore, responsible governmental organs have a significant role by implementing certain instruments and mechanism that support those linking activities (Stoker 1998, Borras et al., 2012).

The creation/existence of opportunity structures and capable agents that allow for inclusion and participation, and an enabling institutional setting closely shape the behaviour of the innovators and the inter-organizational relations of actors in networks (Freeman 1995).

Outcome:

Insights from the Governance of change literature highlight the existence of opportunity structures and participatory and inclusive proceeding for successful innovation, and change actions. This is included in the InnoForESt analysis framework. The factors summarised in Table 6 are extracted from the concept of governance of change. Those factors need to be defined and further developed through the following steps of the project, including the interaction with scientific partner and practitioners.

TABLE 6 FACTOR SUMMARY OF GOVERNANCE OF CHANGE

Dimension	Factor	Factor Subgroup/ Examples
Governance Innovation Process		
	Opportunity structures and capable agents	Governance mode
	Governance instrumentation for participation and inclusion	

4.2 Transition Management

Aim:

Transition management provides ideas for practical guidance of transition of a system as it involves feedback processes, monitoring needs, and building on ideas of social learning. While the governance of change concept focuses on agents and institutions that create spaces for change, transition management emphases phases for transition as feedback and learning loops. Both concepts include key aspects of intentional innovation development that may lead to intended outcomes by processes of participation, experimentation, monitoring, feedback and learning.

Elaboration:

Transition management is intended to catalyse processes of change through different modes of visioning, experimentation and learning. Creating common visions, initiating experiments and learning processes are central elements of this approach (Kemp, 2007). Starting with a common vision, stakeholders shall first work on a common ideas of problem perceptions to come up with shared objectives and visions on solutions. The shared visions create long-term objectives. Such a vision can be elaborated e.g. in workshops and/or interviews, and needs to be validated through experiments in order to create a shared learning process and reflect results from implemented actions and developments of the innovation.

Transitions usually start at a niche-level to test certain innovations/alternative pathways and learn through those processes. These learning effects create feedback, in order to see what is supportive for the sustainable change of the innovation and what needs to be adapted. This can be called feedback loops as the participants learn by doing and doing by learning.

Important for initiating transitions is the regime level (see MLP in section 3.3), as it is here where influence and power of actors are crucial within transition processes (Geels, 2002b, 2007). Path dependencies are a result of existing regimes and institutions in use. It is important to understand those path dependencies and the individual levels of the actors, as they finally decide if transition will happen or blocked because of uncertainty of the future development of the innovation itself. Niches can become part of the regime, or destabilise the regime and replace it, if path dependencies are “destroyed”. This requires possibilities for coordination, legitimation and participation in niche development and action, including creative destruction in order to reduce support for less sustainable methods, processes and policies. The development of the niche can happen bottom-up, if strong enough to break through, or top-down, when changes/shocks in landscapes ease the expansion of the innovation. A hybrid, as a third version would be the inclusion of a niche regime via learning and adaptation processes in order to

improve the performance of the regime itself. Transition management cannot be steered/managed completely, but it is possible to influence its processes via wide participation to reach legitimation and acceptance.

Outcome:

Transition Management can support upgrading and upscaling processes of InnoForESt governance innovations by providing means (CINA workshops) for common visioning on innovation future objectives, as well as its intended objectives and roles of actors. It further initiates the creation of protected spaces, i.e. niches, for experimentation, monitoring, exchange and learning. These spaces are used for prototype testing and assessment and further implementation in other areas, including monitoring and learning curves, feedback loops, long-term vision, short-term goals, shared definitions and level of adaptability, as summarised in Table 7.

TABLE 7 FACTOR SUMMARY OF TRANSITION MANAGEMENT

Dimension	Factor	Factor Subgroup/ Examples
Governance Innovation Process		
	Adaptability	Flexibility to change
	Learning curves and feedback loops	
	Long-term vision	
	Short-term goals	
	Policy Instrument	Creative destruction
	Shared definitions of visions, goals, problems	

4.3 Foresight Approaches and Scenarios

It is crucial to understand dynamics, characteristics and events of the historical development of innovations. Understanding and using the insights of the past, helps us to better predict future events and characteristic constellations of innovations and its dynamics by using foresight approaches and scenarios. The combination of Foresight approaches, scenarios and transition management supports the elaboration of shared visions and a guideline to reach them under controlled supervision.

Aim:

Behavioural and foresight science follows a similar idea as creative destruction and can be seen as a precondition for it. When choosing factors and possible adaptions, it is important to create conditions that provide incentives instead of changing habits and at the same time make unsustainable habits more difficult (Kleinhückelkotten, 2016). Foresight and scenario approaches are means to stimulate thinking about future innovation conditions, making participating actors aware of the respective chances and challenges.

Elaboration:

Foresight and scenario approaches related to innovation process management are rooted in the conceptual work of technology assessment (TA). While early TA attempted to forecast the societal consequences of technological innovations with the help of expert assessments (Berkhout, 2002; Borup, 2002; Salmenkaita, 2004), recent approaches seek to open the process of technological design to broader societal concerns, often in direct interaction with affected societal groups. The underlying conceptionalisation is of technologies that are responsive to societal concerns and adapted to their implementation contexts from the very start, i.e. from the initial design phase. This shift in thinking recognises the fundamental limits of prediction and political intervention once technologies have developed to an implementation-ready state. By then a high degree of path dependency has been

established, for example through the development of dedicated infrastructures and constitution of vested interests that resist regulation attempts (Collingridge, 1980).

More recent approaches in TA are based on a (quasi-)evolutionary understanding of technological change which regards technological innovation as an open-ended process, shaped in interactions between various actors and stabilising gradually over time (Dosi, 1982; Geels, 2002a; see Grunwald, 2014; (Belt, 1987). A guiding orientation in these recent approaches is the understanding that technology is constructed in social interactions (Bijker, 1987) and through the establishment of discourses that imbue technological projects with specific expectations and meaning (Lente, 1993; Pfaffenberger, 1992; Staudenmaier, 1985).

To ensure that technology meets societal demands, societal interactions must be integrated into the earliest stages of technology development and not only considered retrospectively as a response to it. In practical terms, this requires the involvement of a broader range of societal perspectives, going beyond networks of technology designers to include social groups who are able to voice critical perspectives on the technological project in question (Garud, 1997). Negotiating with and incorporating these views, so that they play a formative role in the design and development of technology, will result in more robust and societally embedded technologies (Robinson, 2009).

Consequently, a conceptual shift has occurred among researchers, a move away from purely scientific research to participatory analysis, and from prediction towards a more exploratory stance that takes full account of developmental contingencies and uncertainties. This provides the basis for reflexive learning and 'real-time' assessment (Guston, 2002).

Such a shift towards a broader understanding of socio-technical dynamics, with an emphasis on anticipation, articulation, and feedback, has come to be known as Constructive Technology Assessment (CTA) (Raghu Garud, 2001; Rip, 1995; Schot, 1997). Methodologically, CTA builds on a scenario approach to trigger and frame prospective debates on socio-technical dynamics and the repercussions of technological innovations. Scenarios are constructed based on studies into the past and present dynamics of technology development which constitute their 'endogenous futures', i.e. their open, but not unlimited, potential to continue historical development pathways into the future (Rip, 2008). Innovation dynamics within such socio-technical systems are explained with the help of a multi-level perspective model (Grin, 2011; Kemp, 2007; Loorbach, 2007, 2010) that takes three levels of technology-related interactions into consideration. A micro level of ongoing innovation activity ('technological niches'); a meso level comprising a system of institutions and networks which define basic functional requirements and design parameters for a certain area of technology development ('socio-technical regimes'), and a macro level that forms a wider, external backdrop of structural developments that influence technology development ('socio-technical landscapes'). By taking multi-level interactions into account, CTA serves as an `intentional bridging event´ (Rip, 2008) for uniting actors who shape and view technology through interactions that take place on and across these different levels.

Outcome

Similar to CTA, the InnoForESt CINA approach encourages the development of a range of scenarios while also encouraging actors to constructively discuss issues and challenges for the future of governance innovations for forest ecosystem service provision. Based on the analysis of innovation influencing factors, the scenarios portray innovation dynamics as an entangled process of innovation-making and their use in specific situations and contexts. Real-world actors, organizations and institutions that are identified in the course of the analysis, as well as critics or opposing positions and approaches as their hypothetical counterparts, are associated with the distinct levels (micro or meso) and surrounded by macro-level trends and shifting agendas. These elements influence each other and policy innovations.

Actors' roles differ in each scenario: what may be considered an opportunity for a particular actor in one scenario might be taken as a constraint in another.

Scenarios help to identify the potential for creating new links between actors, activities, and levels so that the opportunities and risks of different innovation development pathways can be assessed. This process of identifying issues and challenges is largely left to the participants. Instead of positioning ourselves as scientific advisors for the development of new innovations, we engage with ongoing innovation processes as learning facilitators (Fischer, 2003). Our role is to stimulating debate around the innovation design process and its societal implications. We enrich this discussion by introducing, via the scenarios, diverse viewpoints and concerns that do not usually attract the attention of the centres of expertise from where governance practices are increasingly shaped.

5 Dimensions and Factors of the SETFIS Analysis Framework

This chapter coherently presents the system dimensions and sets of related influencing factors extracted from the previous chapters as an overview, including a backlink to the concept and theory. The second section of this chapter provide a visualised version of the SETFIS analysis framework.

Building on the conceptual system dimensions of social-ecological-technical forestry systems (SETFS), sets of innovation factors are presented that may play a role for governance innovation emergence and development. These factors are in line with work of WP2 mapping activities and be taken up for prototype development (WP3), innovation further development (WP4, WP5) and for developing policy and business recommendations (WP6).

As explained in the beginning, the set of influencing factors is initial, and needs to be further extended and potentially adapted, based on empirical finding in case study and other WP activities. Therefore, the created framework provides one tool to frame and to analyse different institutionalized action situations, in order to extract crucial factors for the innovation.

5.1 Explanation of the SETFIS Analysis Framework

The outcome of previous efforts on theories, concept and innovation process developments is summarized in the following chapter in the SETFIS Analysis Framework in order to better understand governance innovation processes in the context of the InnoForESt project. Figure 7 shows the system dimensions of the analysis framework. The factors evaluated in this document are not displayed in the figure but presented in section 5.2 summary of key Innovative dimensions and related factors.

The y-axes represents the level of analysis within the multi-level innovation system, ranging from local to regional to national and to EU level applications. This is important for future analysis of governnace innovations, as it indicates the upscaling potential as development paths for further diffusion of the innovations in relation to the responsible level of each dimension.

The x-axis shows the different stages of innovations and therefore the time sphere, which needs to be considered in the analysis. Between the two axes is the framework with the different system dimensions as the Governance System, comprising Institutions and Actors, Innovation System, Forest Management System and Biophysical Ecosystem. The center of the framework exists of governance innovation process as an action situation that represents the dynamics between the different system dimensions and therefore the innovation process.

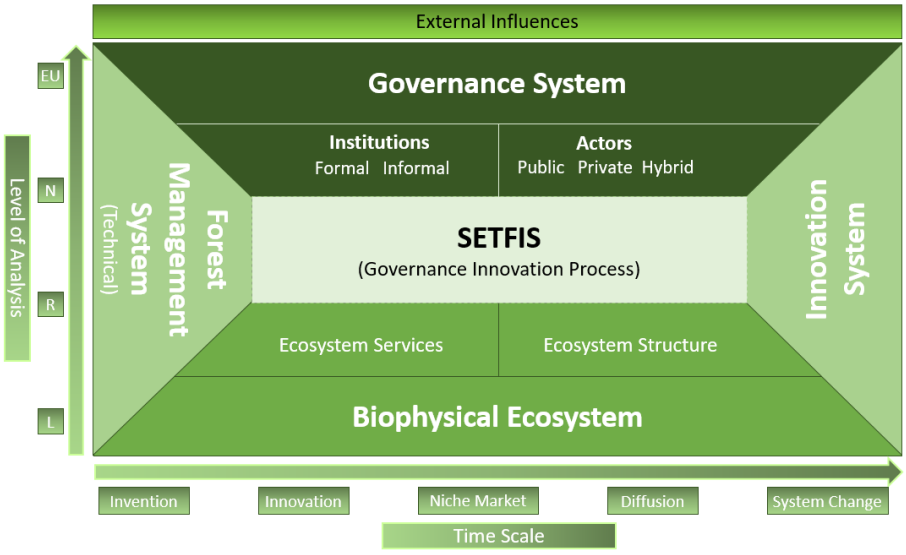

FIGURE 6 ANALYSIS FRAMEWORK FOR ECOSYSTEM SERVICES GOVERNANCE INNOVATIONS

5.2 Summary of Key innovation system dimensions and related factors

Key innovation system dimensions and related factors that are central for governance innovations are presented in the following part and serve as an indication for future innovation development within the SETFIS environment.

The literature review revealed a description of seven system dimensions and different sets of influencing factors, respectively. The following Table 8 summarises the system dimensions and related sets of influencing factors that were described in the previous sections. It provides a quick overview on the relations of the system dimensions and related factors. System dimensions and factor types serve as the basis for the analysis framework to shed light on the innovation situation in the case study areas, and to describe what influenced governance innovation emergence, development and spread.

TABLE 8 SUMMARY OF SYSTEM DIMENSIONS AND FACTORS OF THE ANALYSIS FRAMEWORK

Dimension	Factor	Factor Subgroup/ Examples
Actors (Governance System)		
	Types	Public, public-private, private
		Socioeconomic attributes
	Roles and rights	Property rights, ownership
	Relation to ES	Beneficiary
		Provider/dependency
	Collaboration	Networks (adaptive networks)
	Categorization of actors (According to their area of action and influence)	Innovation pioneers, enablers, change agents macro-, meso-, micro-actors (vertical vs. horizontal)
Dimension	**Factor**	**Factor Subgroup/ Examples**
	Level of adaptation, resilience	Continuity, changes
	Knowledge of SES	
	Information	Access, sharing
	Conflict resolution	Winner/looser
	Relationships, power relations	
	Participation	Inclusion, exclusion (e.g. meetings); representation/underrepresentation
	Acceptance & legitimacy	
	Lobbying	power
Institutions (Governance System)		
	Institutional interplay	
	Regulation	
	Hierarchy	Formal institutions (hard regulation), (laws, command-and-control policies, statutes, property rights) Formal institutions (soft regulation), (Information/advisory instruments (guidelines, information technology and platforms, extension and advice) Informal rules (traditions, habits, norms, trust)
	Markets	Market-based instruments (taxes)

		Voluntary markets (trading systems, payment schemes)
		Private-to-private (+with intermediaries)
		Market-like arrangements organized by government (e.g. conservation tenders)
	Polycentric Approach	Distributed authority
	Networks (self-organised)	Public-public, public-private, private-private, polycentric/hybrids (cooperatives)
	Policy Instruments (Support by Government)	Creative destruction, Incentives (compensation), Subsidies, R&D policies (financial support for science), Patents, technology, niche support, networking support laws, possibilities of access)
		Information/advisory instruments
	Niche developments	Niche level, regime level, landscape level (exogenous influences)
Biophysical Conditions		
	Ecosystem service type	Supporting, provisioning, regulating, cultural
	Ecosystem structure	Clarity of system boundaries, size of resource system, equilibrium properties, predictability of system dynamics, interaction among resource units, economic value number of units, distinctive characteristics, spatial and temporal distribution
Dimension	**Factor**	**Factor Subgroup/ Examples**
(Biophysical Conditions cont.)	Importance, involvement and impact of ES to innovation	
Forest Management System		
	Entrepreneurship Capabilities/leadership	
	Technical competencies	
	Business model	Tourism, bioeconomy, food, wood, etc.
	Financing structure	
	Certification in use	FSC, PEFC, not implemented
	Forest Management System	Clear-cut Clear-cut with retention trees Clear-cut with retention habitats Continuous cover forestry / selective, single-tree removals, coppice, close-to-nature management, afforestation (new plantations, e.g. on former agricultural land), agro-forestry (e.g. wood pastures and shelter trees)
	Technology	Technology available, technical support
	Impacts	
	Unintended FMS	
	Transferability	
	Local, regional, national, European, international/UN, etc. development	
Innovation System		
	Innovation type	Product, process, service, market, social innovation
	Development stage (time scale)	Invention, innovation, niche market operation, diffusion, system change

	Level of analysis	Local, regional, national, EU, European, International/global
	Development strategy (time)	Open-ended or closed process
	Control systems	Monitoring and evaluation
	Barriers to the innovation	
	Sustainability of innovation	
	Improvement	Feedback loops
	Related innovations	Supporting Innovations, supplementing innovations, similar innovations, competing innovations,
	Spill-over effects	Positive/ negative
	Part of larger development	Megatrends, past events, social/historical pressure, etc.
Governance Innovation Process		
	Adaptability	Flexibility to change
	Learning curves and feedback loops	
	Long-term vision	
Dimension	**Factor**	**Factor Subgroup/ Examples**
(Governance Innovation Process cont.)	Short-term goals	
	Creative destruction	
	Shared definitions of visions, goals, problems	
	Opportunity structures and capable agents	Governance mode
	Governance instrumentation for participation and inclusion	
External influences		
	Related ecosystems	Climate & pollution patterns
	Social, political, economical	Political stability, other governance systems, markets, economic development, technology, demographic trends, media organizations

6 Operationalisation of the SETFIS Analysis Framework

This chapter explains how the analysis framework is practically applied in the InnoForESt project. The SETFIS analysis framework is used as a complementary mean for better understanding of the governance innovation situation in Innovation Regions. In addition to WP2 biophysical and institutional mapping activities on EU and national level, as well as WP4 and WP5 activities on stakeholder analysis and innovation assessment, the analysis framework helps to identify key influencing factors on governance innovations for prototype development, assessment, and for stakeholder recommendations. Applying SETFIS will support the process to identify crucial influencing factors for each Innovation Region to concentrate on in further steps of the InnoForESt project.

Therefore, besides the identification of factors that played a role for innovation development, the degree of factor influence shall be further explored by the SETFIS user. It shall be determined if a factor is of major or minor importance for the innovation development process. This can be done e.g. with help of expert rating and/or weighting exercise in the course of expert interviews, focus groups or part of stakeholder workshop. In addition, it needs to be explored if the identified factor is of fostering or hindering influence for the innovation. Table 9 provides an extensive list of the defined system dimensions and related factors as well as columns to be filled in with information regarding a) the relevancy of factors in a specific Innovation Region, b) their importance, and c) the direction of influence. This information shall to be collected and stored by SETFIS users. It provides an important information basis for prototype development, prototype assessment, and for drawing policy and business recommendations. Feedback processes from its empirical application will improve the understanding of governance innovation processes in Innovation Regions and beyond. Due to its common application and conceptual foundation, SETFIS helps to identify common and distinct innovation process patterns among innovation types and the Innovation Regions. In addition, on a conceptual level, any feedback will help to continuously improve the analysis framework.

6.1 Application of the SETFIS Analysis Framework in the InnoForESt Project

The SETFIS Analysis Framework intends to improve understanding of governance innovation emergence and development processes. Moreover, it enables stakeholders with help of a good understanding of past-present innovation dynamics in terms of system dimensions and factor characteristic, to purposefully create innovation-friendly system conditions, by concentrating on key influencing factors that are favouring intended development paths. The analysis framework highlights the dimension/factor interdependencies, respectively the outcome of the action situation and therefore the feedback to system conditions, the crucial factors and/or may adjust the framework through empirical results. The results will provide insights to the long-term innovation dynamics, from the past to the future (Castillo, 2011).

For application, the SETFIS Analysis Framework serves as a checklist for dimension and factors that may have influenced innovation dynamics. Some of the indicated information may already be elaborated by other work packages and Innovation Region activities and don't need to be doubled! Missing information appears as blanks and become subject of further exploration. Table 9 "Supporting list of questions" is to be successively filled with information generated by SETFIS application and insights coming from other information sources (e.g. Deliverables, workshop reports). As such, it delivers system-based information on fostering and hindering context conditions for innovations to develop, and for their further improvement and/or upscaling in a particular context.

Cross Innovation Region comparison can then reveal patterns of innovation development influences being of more general nature and the ones that appear to be very context-specific. When the historical and current setting of governance innovations is known, road-mapping strategies according to stakeholders' visions can be jointly developed, and policy and business recommendations drawn to transform the innovation vision into the future reality that is the next innovation stage or the next application level or scope.

Figure 7 suggest a stepwise process for the application of the analysis framework.

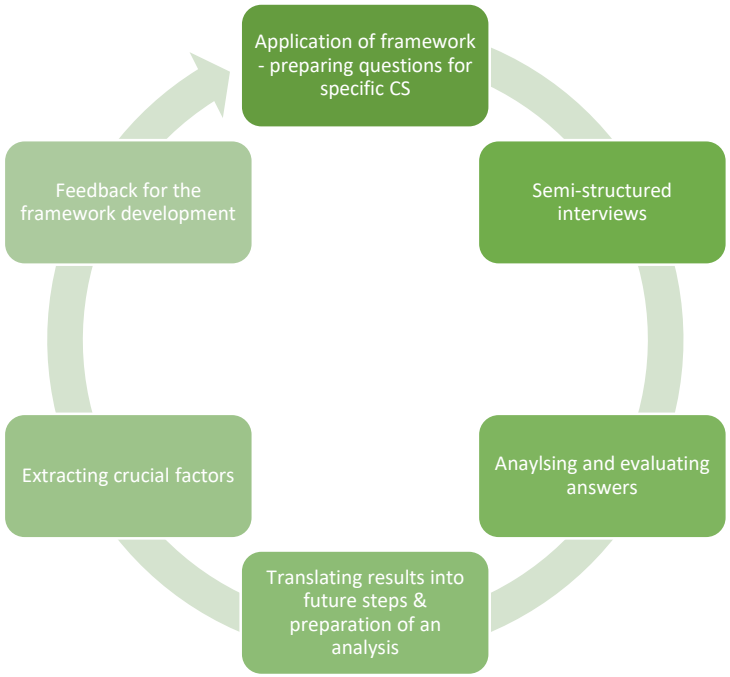

FIGURE 7 APPLICATION AND DEVELOPMENT CIRCLE OF THE ANALYSIS FRAMEWORK

1. *Application of framework:* First, the system dimensions, including factors and external influences, and in a second step the innovation process itself, need to be transferred into questions for the semi-structured interviews. A question catalogue is provided in the section 6.2. Important to remember is the level of analysis and the current development stage during the interviews, because every single level/stage requires a different data set, which needs to be considered. It is not mandatory, neither necessary, to ask or use all of the questions. Some are already answered by Innovation Teams or other WP activities.
2. *Data generation:* Required data for framework application will be generated, e.g. with help of semi-structured interviews, focus groups or workshops with stakeholders in Innovation Regions. The provided question catalogue should be seen as a supporting tool for upcoming workshops and interviews.
3. *Analysing and evaluating results:* Answers from the interviews need to be coded and analysed. The coded answers than have to be categorized to a specific valuation of dimensions/factors that has to be evaluated during the workshops and interviews.
4. *Translating results into future steps & preparation of an analysis:* The answers need to be translated into future steps for the respective actors and provide a useful analysis for practitioners. The analysis could deliver an overview on the factors that are developed well and the ones with potential to improve, as well as possible threats and opportunities in order find options to upgrade the innovation or increase its resilience.
5. *Extracting crucial factors:* Results from the interviews may create/define crucial dimensions and factors, as well as new combinations for further development of the innovations in prototypes.
6. *Feedback for framework development:* Final results, new factors and factor relations shall serve as a basis for prototype development. In addition, feedback shall be used to continuously improve and develop the analysis framework for future analysis.

6.2 Applying the SETFIS Analysis Framework in Practice: A Supporting List of Questions

Preface

This supporting list of questions is a guideline to apply the InnoForESt analysis framework in Innovation Regions. The guideline helps to elaborate on the range of factors that have potentially influenced the InnoForESt governance innovations in focus, and to identify their degree as well as direction of influence. The list of questions is structured along the seven system dimensions anchored in our extensive literature review. In the following, we provide a catalogue of question that help SETFIS users (from the InnoForESt project team) and further stakeholders from various fields of work) to find out about the governance innovation's fostering and hindering factors and conditions.

Please note

The set of questions for each factor dimension are meant as an orientation to elaborate on innovation influences; they are open to *further influences* which are deemed important by interviewees. We inserted open questions in each set of questions as well as a blank table at the end of table 9 to improve our understanding of governance innovations design and functioning, and to enlarge the conceptual orientation, as a deductive-inductive interplay. Also, not every question has to be asked by the SETFIS user, in particular when information has been already gathered by other project activities. Therefore, it is important that SETFIS users indicate the source of information in the last column on the right in the table.

In addition, the *sequence of analysis questions* does not need to follow the sequence of dimensions as presented in this guideline; interviewees are free to reshuffle, combine questions or change them to yes-no answers on a questionnaire to ease the evaluation. However, for reasons of comparability among the different innovation cases, all dimensions should be covered in the interview.

Factor system dimensions covered in the list of questions:

Dimension 1 – Actors (Government System)

Dimension 2 – Institutions (Government System)

Dimension 3 – Biophysical Conditions

Dimension 4 – Forest Management System

Dimension 5 – Innovation System

Dimension 6 – External Influences

Dimension 7 – Governance Innovation Process

TABLE 9 SUPPORTING LIST OF QUESTIONS

Dimension 1: Actors (Governance System)					
The focus of this set of questions is to elaborate on actors, specifically to get to know their characteristics and interactions in relation to the innovation in the past, present and future.					
Question	**Factor** (and additional factors mentioned)	**Answer**	**Importance of factor** (e.g. not important to very important)	**Impact of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)
- Who is involved in the innovation? Please describe the **type and affiliation** of actors, e.g. types: institutional, service, social innovation	Type of affiliation				
- What are the different **roles** and **functions** of the involved actors for the innovation?	Roles/functions/rights				
- What **form of collaboration** is used between actors? (*networks, cooperatives, collaboration, loose, close*…)?	Form of collaboration				
- Has the actor **constellation evolved and changed** over time? If so, has this influenced the innovation?	Evolvement, continuity and change of constellation				
- Do **regular meetings on the innovation** exist between actors and regular are they held? Which issues are discussed?	Regular meetings				
- Which actor **benefits** from the innovation? Are they also dependent on the innovation?	Beneficiary/Dependent/relation to ES-GI				
- Who can change the innovation (e***.g., rights to change the design and functioning, use and application, finances, others***)?	Changer/ categorization of actors				
- **Which** other **actors** in the region (and beyond) that **support** the **innovation**? Who, why? Not actively involved	Supporter/ categorization of actors				
- Which actor could **enable certain processes** that are important for the future development of the innovation?	Enabler/ categorization of actors				

- Which **actors/groups** are **against** the **innovation? Why?**	Hinderer - categorization of actors				
- Are actors **excluded** from using the innovation (**purposely/ unintentionally**)? Who are these actors?	Participation (inclusion, exclusion)				
- Who has access to **information** about the innovation? (***everyone,*** *certain* ***stakeholder, etc***.)	Access to/sharing information/ power relations				
- Are there any **conflicts** related to the innovation? What kind of conflict? How to deal with it?	Conflict (resolution)/ power relations				
- Which **lobbying** activities have been realised in order to push the innovation?	Lobbying/ power relations				
- How is the innovation **perceived** in its environment, e.g. the forestry sector, outside of the current innovation system?	Actors' perception (acceptance and legitimacy)				
- Do you plan to include **further actors in the future**? If so, who and why?	Possible future actors				
- Anything else important regarding principal actors that influence the innovation?	Additional				
Dimension 2 – Institutions (Governance System)					
This set of questions elaborates on the influence and effect of rules such as regulations, laws, statutes, but also traditions and habits that influence the innovation in the past, present and future.					
Question	**Factor** (and additional factors mentioned)	**Answer**	**Importance of factor** (e.g. not important to very important)	**Impact direction of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)
- Particularly check in detail following policies: Have the following **policies** and **strategies** an **effect** on the innovation: Forest Law, Natural Conservation Law, Biodiversity and/or Bioeconomy Strategy (state, national, EU, international level)?	Impact of existing policies				

- Is the innovation **supported by government**? How?	Government support				
- Where there any **policy changes** in the past that had a crucial influence **on the innovation?** Which ones and how (positive/negative)**?**	(Institutional) Policy-change impact				
- Have **political changes** affected the innovation like elections, **parties etc.?** If so, how?	Political-change impact (e.g. elections)				
- Which **policies** are **hindering** the functioning of the innovation, and why**?**	Hindering/related policies (Hierarchy: hard/soft regulations)				
- In contrast, what **other policies** could support the innovation, and how?	Additional policy support/ related policies				
- Which specific **traditions**, **cultures** or **habits support or hinder** the innovation?	Traditions, culture, habits (informal rules)				
- How **decision processes** organized within the innovation environment? In a more **central** or **decentral** manner? (networks, PPP – polycentric/hybrids)	Multiple-centres of semi-autonomous decision-making structures (polycentric approach, networks)				
- Which particular **market conditions support or hinder** the innovation?	Markets				
- What could be changed in the institutional environment **to help the innovation to develop**? (support by government: creative destruction, incentives, subsidies, R&D,)	Policy instruments				
- Could the innovation **create a new policy setting**/law etc.? If so, which one?	Impact on policy setting				
- What is/was important for **change** and **continuity** in order provide **resilience** to the innovation?	Change/continuity/resilience				
- Which **monitoring and sanctioning** rules existent within the innovation environment?	Monitoring/ sanctioning				

- How is **public participation** arranged within the innovation environment?	Public participation				
- Are influences from **various institutions** existent? If so, how?	Influences from other institutions				
- Are there advisory instruments that support the development of the innovation?	Advisory instruments				
- Anything else important regarding the institutional context?	Additional				
Dimension 3 – Biophysical Conditions					
This set of questions targets the biophysical/natural environment and explores the influence and relation of those conditions on the innovation in the past, present and future.					
Question	**Factor** (and additional factors mentioned)	Answer	**Importance of factor** (e.g. not important to very important)	**Impact direction of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)
- What **type** of Ecosystem Service (ES) does the innovation provide/foster? (provision, regulating, supporting, cultural)	ES Type				
- Where these **ES provided also before** the innovation existed as well? To a different degree?	Provision w/o innovation				
- How is the local ES structure defined? (boundaries, size, economic value, dynamics/temporal distribution etc.)	ES structure				
- What particular **biophysical /natural conditions are important** for the functioning of the innovation?	Required conditions of ecosystem for functioning innovation				
- How do **changes in biophysical/natural conditions** influence the innovation?	Influence of ES on innovation				

- Which **other ES** are provided by the biophysical environment that are out of scope of the innovation? (regulating, provisioning, cultural, supporting)	Other ES				
- Has the **ecosystem** been **improved** by the innovation in relation to its objective set in the beginning? If so, how?	Improvement of ES by innovation				
- How could the **biophysical conditions be improved** for ecosystem service provision?	Possible improvement of biophysical conditions				
- What may be **acute risks** for the ecosystem that can **hinder the provision** of ecosystem services?	Acute risks				
- Anything else important regarding the influence of biophysical/natural conditions?	Additional				
Dimension 4 – Forest Management System					
This set of questions focus on the management of forests and influence of technical and financial infrastructure for the innovation in the past, present and future.					
Question	**Factor** (and additional factors mentioned)	**Answer**	**Importance of factor** (e.g. not important to very important)	**Impact direction of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)
- Which particular **forest management strategy** is necessary for the Innovation (type of FMS – clear cutting – changing)?	FMS				
- Does the innovation require any **particular infrastructure** such as paths/networks, **technologies**, digital infrastructure, machinery etc.? If so, why?	Infrastructure/technologies				
- Does forest **or other certification** schemes play a role for the innovation *(e.g. FSC, PEFC)*? If so, how do they influence the innovation?	Certifications				
- What kind of **forest ownership** is necessary for the innovation? (PPP, public, private, community based)	Type of forest ownership				

- Are specific (forest) **entrepreneurship** skills necessary for the innovation? If so, which ones? (accounting, calculating, law, etc.)	(forest) Entrepreneur-ship				
- How **flexible** needs forest management system to be for the innovation to work?	Management flexibility				
- How is the innovation **financed/finance structure**?	Financial structure				
- Is there any **external financial** support or others types that could provide resources to the innovation?	External funding				
- How do the **monitoring** systems of the ES work, which are important for the innovation?	Monitoring of ES/FMS				
- What may be **unintended effects** on forest management by the innovation, or the other way?	Unintended effects				
- How could **changes in forest management support** the innovation? Which ones?	Support via FMS				
- Can the required forest management system/strategies be **transferred** to other areas (region or countries)? Why or why not?	Transferability of FMS				
- What may be feasible **impacts** of the innovation in terms of local/regional/national/EU **development**?	Development impact				
- Anything else important from forest management?	Additional				
Dimension 5 – Innovation System					
This set of questions focus on the type of innovation itself, the underlying reasons for its establishment, its current status, past developments and future needs.					
Question	**Factor** (and additional factors mentioned)	**Answer**	**Importance of factor** (e.g. not important to very important)	**Impact direction of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)

- What was the **initial idea** for the innovation to be established? Any particular reason?	Initial idea				
- What is/was necessary to provide the required space for the innovation to work (regulations, actors, external processes)?	Niche developments				
- What were the **main expectations** concerning the **outcomes** of the innovation? Fulfilled?	Fulfilment of principal main expectations				
- Has the **initial strategy** of the innovation development been **changed** over time? How?	Initial strategy/ change				
- Has the **application scope** of the innovation changed over time? How? (local, regional, etc. – level of analysis)	Application Scope Sphere of innovation action				
- How would you characterise the **type of innovation**? (*Product innovation, process, service, market, social, policy, business…other?)*	Type of Innovation				
- How would you characterise the current **development stage** of the innovation? (Visioning (promises), Promoting (planning, developing, investing in R&D), Implementation (piloting, allocating responsibilities, resources, to activities), Upscaling (significantly adding resources and responsibilities, e.g. expanding the area)	Development stage				
- Are there any **control systems, monitoring and evaluation** procedures that provide **feedback** to the stakeholders of the innovation (feedback loops) and indicate emerging **problems**? If, how do they work?	Control systems (monitoring, sanctioning) feedback loops				
- Do **similar** innovations exist (in the region)? Are they competing or supplementing each other? Or do they work as are there supporting innovation?	Related (similar/ supporting) innovations				
- What would you like to **improve in the future** (application scope, functioning, impacts…) of the innovation**?**	Prevention, not compensation				
- How could generally an **innovation-friendly environment** be fostered in the region? Similar to one before	Innovation-friendly environment Cost calculation				

- What kind of **barriers** to the innovation have been recognized?	Barriers				
- Is the innovation open-ended or a closed process in terms of time?	Open-ended or closed process (time)				
- Is InnoForESt **supporting** the innovation so far? How (not)?	External support				
- Anything else important to know about the innovation itself?	Additional				
Dimension 6 – External influences from larger context beyond case study region					
External influences that have/may have an influence on the innovation is the central part of this set of questions. These factors are about influences of larger scope and impact on the innovation in the past, present and future, we cannot directly influence.					
Question	**Factor** (and additional factors mentioned)	**Answer**	**Importance of factor** (e.g. not important to very important)	**Impact direction of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)
- Do **global environmental crises** such as **global warming** or **biodiversity** loss affect the innovation? If so, how?	Climate change, part of larger development (e.g. megatrend, past event, pressure)				
- What would be an **external threat** to the innovation? (social, political, economic)	External threat				
- How could the innovation be affected by **external markets?**	External markets (Focus on regional solutions)				
- Have **positive/negative externalities**, even a **transfer** of the innovation, been recognized? If so, which ones?	Spill-over effects				
- Anything else important to know about external influences?	Additional				

Dimension 7 –Improvement of Governance Innovation Process					
This set of questions focuses on the possibilities to upgrade and/or to upscale the innovation in the future, and how these possibilities can be influenced.					
Question	**Factor** (and additional factors mentioned)	**Answer**	**Importance of factor** (e.g. not important to very important)	**Impact direction of factor:** fostering: + or hindering: -	**Source** (interview with stakeholder; CINA; RBG; Deliverables + number)
- What is your **vision for the future** of the innovation?	Vision (long-term)				
- How can the innovation be advertised/**increase social knowledge**/acceptance?	Social knowledge				
- What are the upcoming decision and goals short term?	Short term goals				
- Have you noticed specific learning curves (increase of learning through experience) during the whole development of the innovation? How has it been noticed?	Learning curves				
- Are **definitions** of goals, problems and visions along the management of the innovation **collectively understood**?	Shared definitions of goals, problems, visions				
- Which **radical choices** to be decided in the future that effects the innovation? What about the past?	Radical Choices				
- What needs to be changed in order to create **opportunity structures** and include important and crucial **(capable) agents** (e.g. politicians, investors)?	Opportunity structures and capable agents				
- What are **other** factors/ processes/ actors/ policies/ constraints that should (not) be changed, added, deleted, etc. to improve the future development of the innovation?	Additional: Networks				

6.3 Quantitative Supplementation

As a recommendation, quantitative data collection may serve the analysis of SETFIS in order to gain a deeper insight and prove findings from the interview question presented in the previous chapter.

The answers from the question catalogue will provide us information and indirect recommendations how to improve the analysis framework. In addition, collecting quantitative data may add supplementary value to the results. This type of data can further validate and proof the results, plus it can be used for the conceptualisation of future scenarios. Especially certain relations between the factors can be better explained and shown through mathematic models, e.g. certain regression analysis. It could help to clarify the relation between broader context variables and collective and individual behaviour as a cause or consequence of a certain of the rules of institutions or networks (Castillo, 2011).

7 Appendix

7.1 Example of Analysis Dimensions, Factor Categories and Factors for Analysis

The German case *Waldaktie*

Let's assume as an outcome of the Innovation Region analysis of influencing factors for the FES governance innovation *Waldaktie*, it turned out influential were a) the department head of the State Ministry for Agriculture and the Environment who had the initial idea, supported by a local forest manager and the tourism office. These three functioned as initial network of actors. In order to compensate for tourists' carbon emission, b) agricultural land suitable for afforestation was made available by a farmer in the region. c) The state forest policy principally allows afforestation in this region, and, d) together with funding coming from agricultural subsidies for nature conservation measures, these proved to be important fostering institutional conditions. e) a group of interested service providers such as a graphic designer and local environmental NGOs, support the idea by selling the *Waldaktie* to tourists. Soon afterwards, f) a more professional infrastructure in form of a visitor centre and institutionalised distribution channels for the *Waldaktie* were created. A process over two years was needed for facilitating this idea of the *Waldaktie* to crystallize. All these developments can be categorised as influencing **factors: key actors, biophysical conditions, institutional setting, funding/markets, infrastructure.**

Now, let us assume that this idea of the *Waldaktie* should be applied in a different context somewhere else, e.g. in the country of Finland. For this, key influencing factors need to be reconfigured in a way, that the *Waldaktie* becomes applicable to the Finish context. Hence the model of the *Waldaktie* needs to be decontextualized and modified.

To determine which of the influential factors needs to be modified for this innovation to work in Finland we undertake a (co-design) process of **reconfiguration** through **experiments**, and other **matching tools and methods** (QCA, Net-Map, SNA…) identified in the **matching framework**. Reconfiguration of key factors for the emergence and development of the *Waldaktie* for the Finnish context can be that key stakeholders are coming from the Finish Environmental Ministry that support its establishment. Further, in this densely forested country, an area need to be identified with enough agricultural land available for afforestation, including the presence of a willing tourism organisations in place that function as intermediary. Moreover, as a required institutional context, the Finish environmental/forestry/nature conservation policies have to provide the opportunity for such kind of carbon offsetting mechanisms. Ideally, already some knowledge about carbon offsetting and compensation schemes is available.

These descriptions of the reconfigured key factors are captured in **prototypes.** Prototypes sketch out future scenarios as "What if" situations: What conditions are needed if the *Waldaktie* ought to be implemented in a Finnish region? The prototype of the *Waldaktie* will be discussed via **CTA** Workshops with stakeholders in Finland to assess chances, risks and challenges of the application of *Waldaktie* in Finland, and to constructively debate about impacts, roles etc.

8 List of Figures

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10 Bibliography

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