Horizon 2020 Societal challenge 5
Climate action, environment, resource
Efficiency and raw materials

D2.3: POLICY SUCCESS STORIES IN THE WATER-LAND-ENERGY-FOOD-CLIMATE NEXUS

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement NO 689150 SIM4NEXUS

PROJECT	Sustainable Integrated Management FOR the NEXUS of water-land-food-energy-climate for a resource-efficient Europe (SIM4NEXUS)
PROJECT NUMBER	689150
TYPE OF FUNDING	RIA
DELIVERABLE	D2.3
WP NAME/WP NUMBER	Policy analysis and the nexus / WP 2
TASK	T2.3
VERSION	3
DISSEMINATION LEVEL	Public
DATE	19/12/2018 (Date of this version) – 30/11/2018 (Due date)
LEAD BENEFICIARY	PBL Netherlands Environmental Assessment Agency
RESPONSIBLE AUTHOR	Maria Witmer
ESTIMATED WORK EFFORT	5 person-months
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ESTIMATED WORK EFFORT FOR EACH CONTRIBUTOR	All cases together ½ PM (WUR-LEI, UTH, PIK, UPM, KTH, UU, UNISS, ENKI, SWW, ACT, BEF, P&W), PBL 4 PM, UNU ½ PM.
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DOCUMENT HISTORY

VERSION	INITIALS/NAME	DATE	COMMENTS-DESCRIPTION OF ACTIONS
1	MW/MARIA WITMER	30-09-2018	MS34
2	MW/MARIA WITMER	11-12-2018	DRAFT REVIEWED BY MARTINEZ, OAKES AND SELNES
3	MW/MARIA WITMER	19-12-2018	FINAL REPORT SENT TO FLOOR BROUWER; COMMENTS BY REVIEWERS ADDRESSED

4	MW/MARIA WITMER	14-03-2019	CONTRIBUTORS FROM ALL CASES ADDED AS CO-AUTHORS

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Executive summary

To assess the success of a nexus policy-making process requires a multi-dimensional and multi-scale approach. The criteria to judge a policy in the water-land-energy-food-climate (WLEFC) nexus as successful were defined for the output and impact of the policy as well as for the policy-making process. These criteria are: 1) Policy output: goals, implementation and instruments are defined in a transparent way, while addressing policy coherence, maximising synergies within and between sectoral policies and managing conflicts and trade-offs at bio-physical, socio-economic, and governance level. 2) Policy impact: the policy should be effective and efficient to reach the agreed goals and be sustainable. 3) Policy process: the process should be fair and transparent, and equally respect interests of stakeholders from different sectors in the WLEFC nexus. As competences are differently divided between administrative levels for WLEFC sectors, and because trade-offs in the nexus cross scales as well as sectors, the governance of the WLEFC nexus is multi-sectoral and multi-scale.

Successful nexus policy-making depends on political will, mindset, knowledge management and careful organisation of the process. There must be the political will to broaden the scope beyond the usual sectoral perspective, focus on common goals instead of narrow sectoral goals, give up individual power for shared interests, invest in a complex and possibly lengthy policy-making process and contribute resources to reach common goals. It takes a mindset that wants to understand perceptions of problems and solutions other than your own in addition to other cultures, interests and visions. It also takes the courage to face uncertainty and complexity that forces an experimental pathway and flexibility, adjusting to new findings and changing circumstances. To be able to do this, an effective monitoring system must be in place. Knowledge about the interconnections and interdependencies between the components in the nexus, as well as knowledge sharing between sectors and scales, are crucial. This is important not only for scientific knowledge, but also knowledge from practice brought forward by stakeholders. Political will for a nexus scope is essential at several moments during the policy cycle: 1) the choice to put an issue on the political agenda and the way it is framed, 2) the design of the policy-making process and choice of parties to be involved, 3) the choices of policy goals, objectives, instruments, and organisation of the implementation, 4) choices about resources provided for and financing of the policy-making process, implementation and monitoring.

Success factors for a nexus-oriented policy-making process are summarized in the Framework for good nexus governance (see tables below). Success factors do not stand alone but are interrelated. Implementation of these success factors should be tailor-made, appropriate for the issues at stake and stakeholders involved. As the list of success factors is quite extensive, the question arises when nexus governance is 'good enough'. This must be explored by applying the Framework in practice.

The added value of a nexus approach stems from the exploitation of synergies between policies, avoidance of conflicts and trade-offs between policies because they were foreseen and addressed, and innovative solutions stimulated by broad cross-sectoral views and relational learning. These benefits should be demonstrated to persuade politicians and policy-makers to use a nexus approach. European policy for WLEFC sectors already reckons with conflicts and trade-offs in other sectors. However, opportunities for synergies are less explored and there is no institutionalised procedure for a comprehensive nexus assessment of new policies. The results of such assessments could define the nexus scope of a policy-making process.

New integrating themes can stimulate a nexus approach. Such themes are for example circular and low-carbon economy related to resource efficiency and planetary boundaries, sustainable supply and consumption of healthy food related to public health, good management of land and water in relation

to climate change adaptation and mitigation and sustainable cities. These themes cross EU DGs, national ministries and scales, and can be considered as integrating nodes of nexus approaches.

Table Success factors for a nexus governance process.

PROBLEM DEFINITION, GOALS SETTING, POLICY-MAKING AND IMPLEMENTATION
KNOWLEDGE MANAGEMENT AND RELATIONAL LEARNING
Generation and Integration of different types of information
• Understanding of interconnections between nexus sectors (biophysical, socioeconomic, governance) • Generation of cross-sectorial and cross-scale knowledge based on the understanding of interconnections between nexus sectors and of scales where influences manifest
Relational learning
• Knowledge sharing across stakeholders, sectors, governance levels • Trust between stakeholders • Understanding of diverse perspectives • Common language across different nexus sectors, common definitions • Awareness of interdependency between stakeholders
DEALING WITH UNCERTAINTY AND COMPLEXITY
Dealing with uncertainty in nexus
• Reckon with unpredictability • Integrate adaptability in planning/flexibility to change with circumstances • Allow for experimentation • Consider multiple possible scenarios for long-term governance planning, including a baseline scenario
Dealing with complexity in nexus
• Feedback loops • Time lags • Different scales
SOCIAL DYNAMICS
Cross-sectoral and cross-scale cooperation
• Do not leave issues unresolved
Leadership that builds bridges between sectors, perspectives and scales, co-leadership
Fair and equal power relations
• Inclusion of all stakeholders from all nexus sectors • Fairness among stakeholders and nexus sectors • Equal priority to all nexus sectors • Responsiveness to stakeholders of all nexus sectors
Ownership of nexus approach, commitment
• Avoid high turn-over of staff
Visioning
• Political will • Common understanding of problems, needs, solutions, goals, etc. • Political willingness to cross sectors (break silo's approach, institutions) • Social willingness (education, thinking in nexus)
Legitimacy
• Build on established framework • Authority to make decisions • Support from Government, legislation, higher authority

• Inclusion/representation of all interests • Public awareness • Transparency for insiders and outsiders of process, progress, vision, goal • Accountability • Fair rule of law
RESOURCES
Clearly and fairly-allocated financial and human resources to support the nexus approach
Long-term support for nexus policy making, implementation, monitoring and evaluation
Clear and flexible progressive implementation guidelines and clearly defined responsibilities, tasks and roles
Capability of actors to boost the change and to change own behaviour
Monitoring, evaluation and reporting
Agreed upon representative and measurable progress indicators for all goals and objectives in the nexus
Well-functioning monitoring, evaluation and reporting

Table Criteria for successful output and impact of a nexus approach

OUTPUT
CROSS-SECTORAL HORIZONTAL POLICY COHERENCE
Synergies exploited
Trade-offs managed or mitigated, transparent choices made in case of conflicting instruments, objectives or goals, arrangements for 'losers'
VERTICAL POLICY COHERENCE
Higher level policies support lower level objectives and instruments, also cross-sectoral
Lower level policies implement higher level objectives and instruments
IMPACT
Objectives and goals met in all sectors (Effectiveness)
Cost-effectiveness/efficiency
Sustainability of project/policy
• People: legitimacy, equality, inclusiveness, fairness • Planet: environmental impacts within planetary boundaries • Profit: project/policy is self-financing or generates income

Changes with respect to the DoA

This deliverable was uploaded three weeks after the official deadline of 30 November 2018.

Dissemination and uptake

This report is targeted at the general public, policy makers and stakeholders at global, European, national and regional scale, researchers inside and outside SIM4NEXUS, students.

Short Summary of results

A Framework for good nexus governance was developed based on literature and cases. The research intended to reveal ingredients for policy innovation in a nexus-driven resource efficient Europe. It formed part of the European Horizon 2020 project SIM4NEXUS, which focuses on the nexus of water-land-energy-food-climate, the WLEFC nexus. Success in nexus policy-making has many dimensions and is multi scale. It concerns the whole policy cycle. Success factors for the policy-making process were categorised into Knowledge management, Dealing with uncertainty and complexity, Social dynamics, Resources and Monitoring. As the list of success factors is extensive, the question arises when nexus governance is 'good enough'. This must be explored by applying the success factors in practice.

Successful nexus policy-making depends on political will, mindset, knowledge management and careful organisation of the process. Uncertainty and complexity require an experimental pathway, so effective monitoring must be in place.

European policy for WLEFC reckons with trade-offs. However, there is no institutionalised procedure for a comprehensive nexus assessment of new policies. The result of such assessment could define the nexus scope of the policy-making process. New integrating themes can stimulate a nexus approach. Such themes are for example circular and low-carbon economy, sustainable supply and consumption of healthy food, good management of land and water related to climate change adaptation and mitigation. These themes cross EU DGs, national ministries and scales, and are hubs for nexus approaches. New institutions, temperate or permanent, can be developed around these hubs to facilitate the nexus policy process.

Evidence of accomplishment

This report was published as weblinks at the SIM4NEXUS and PBL (Netherlands Environmental Assessment Agency) websites.

Glossary / Acronyms

	EXPLANATION / MEANING
NEXUS	An interconnected biophysical and socio-economic system of several interdependent sectors and each sector is equally important and addressed.
NEXUS APPROACH	A way of governance that equally addresses the interests of different sectors involved and that takes the biophysical, socioeconomic and governance connections between the sectors into consideration.
WLEFC NEXUS	The interconnected biophysical and socio-economic system of the water, land, energy, agriculture/food, climate (WLEFC) sectors and each sector is equally important and addressed.
WLEFC NEXUS APPROACH	A systematic process of scientific investigation and design of coherent policy goals and instruments that focuses on synergies, conflicts and related trade-offs emerging in the interactions between water, land, energy, food and climate at bio-physical, socio-economic and governance level.
POLICY OUTPUT	Direct result of a policy-making process, for example a plan with goals and objectives, implementation programme and instruments such as laws, levies, education programmes.
POLICY IMPACT	Changes in society, economy, governance, environment, brought about by policy output. Impact always starts with changing behaviour of people.
POLICY-MAKING PROCESS	The process that leads to the policy output: the problem definition, decision-making about goals, objectives, implementation pathway and instruments.
POLICY CYCLE	The cyclic process of policy-making and revision of a policy: problem definition, decision-making about goals, objectives, implementation pathway and instruments, the implementation itself, monitoring and evaluation, back to problem definition.
SUCCESSFUL WLEFC NEXUS POLICY OUTPUT	WLEFC nexus policy output is successful if goals of all sectors involved in the WLEFC nexus, implementation pathway and instruments were defined in a transparent way, while maximising synergies between policies and instruments, and managing conflicts and trade-offs at bio-physical, socio-economic, and governance level.
SUCCESSFUL WLEFC NEXUS POLICY-MAKING PROCESS	A policy-making process that is fair and transparent, equally respects interests of all stakeholders involved from the WLEFC sectors and leads to successful policy output and impact. Decisions are made well-informed about WLEFC nexus relations and interdependencies.
SUCCESSFUL WLEFC NEXUS POLICY IMPACT	Changes in society, economy, governance, environment, caused by the policy, that lead to reaching the agreed WLEFC goals effectively, efficiently and sustainably.
RBMP	River basin management plan.

1. Introduction

This research was part of the European Horizon 2020 project 'SIM4NEXUS'. The goal was to highlight policy success stories in nexus approaches and give examples of those cases and policies that already had been using systems thinking to coordinate policy across nexus areas and scales. The search intended to reveal key 'ingredients' for policy innovation in a nexus-driven resource efficient Europe. Links, similarities, differences and variations in successful nexus approaches were detailed, in search of a generic taxonomy or categorisation of success factors and good practices.

The study described in this report builds on the work that was done by Svensson (2018). To define 'successful policy making' from a nexus perspective, she explored theoretical literature about good governance and made an inventory of success criteria and conditions, focussing on interdisciplinary, 'system-thinking' and intersectoral or cross-sectoral processes. She tested these criteria and conditions from theoretical literature against the findings in practice of eight finished and evaluated cases that were judged as 'successful' by the authors. Implemented and evaluated natural resources management approaches explicitly termed 'nexus' are still rare, as the terms 'nexus' and 'nexus approach' have only emerged on the past ten years. Therefore, cases were traced and analysed that did not explicitly call themselves a 'nexus approach', but in fact dealt with several equally important interlinked sectors. The success factors mentioned in these cases were singled out.

Based on these two sources, theoretical literature and the eight cases, a Framework for successful nexus governance was designed and presented to four national, three regional and two transboundary cases of SIM4NEXUS. The cases checked if they could confirm the success factors mentioned in the framework, completed it and added examples of success and failures from practice.

The Sustainable Development Goals (SDGs) and the policy-making process that led to them were analysed to reveal success factors at global scale. The SDGs are considered a complex nexus, as all goals and targets are interconnected. The SDGs nexus goes far beyond the nexus of water-land-energy-food-climate that is studied by SIM4NEXUS.

The report is structured as follows: Chapter 2 describes the Framework for successful nexus governance, which consists of a categorisation of success factors and good practices. This Framework is the output of this study. It is a tool that can support the design of nexus policy-making processes. Chapter 3 summarizes the analysis of the eight finished and successful cases that applied multi-sectoral approaches of managing natural resources. Chapter 4 describes the contributions of the ten regional, national and transboundary cases of SIM4NEXUS. Chapter 5 describes the analysis of the Sustainable Development Goals (SDGs). Finally, in Chapter 6, conclusions are drawn.

2. Framework for analysing successful nexus governance

2.1 Introduction

In a nexus approach, principles of good governance must be applied (section 2.2) and in addition extra attention must be paid to cross-sectoral and cross-scale cooperation and policy coherence with equal power and weight of all sectors involved. Before we can analyse success factors for a water-land-energy-food-climate (WLEFC) nexus approach, we must define what a successful WLEFC approach is (section 2.3). Political decisions are crucial for all policy-making, but even more for policy making using a nexus approach (section 2.4). Success of policy-making should be measured or judged from its output, impact and policy-making process (sections 2.5, 2.6 and 2.7). Success factors in the policy-making process are described, divided into Knowledge Management, Social dynamics, Resources and Monitoring and Evaluation. Most of these success factors are equally valid for all phases in the policy-cycle of problem definition, choice of goals, objectives and instruments, implementation, monitoring and evaluation.

2.2 General principles of Good governance

In this research, governance is understood as "the sum of the many ways individuals and institutions, public and private, manage their common affairs" (Commission on Global Governance, 1995, pp.2–3). Policy-making and implementation are considered examples of governance.

There is a large body of research on how best to govern natural resources. One concept that has been recognised in the literature and promoted by the European Commission is the concept of 'Good Governance'. The European Commission defines it with five principles (Table 1, European Commission, 2001). Other principles that are commonly found in the literature are summarised in Table 2. These principles represent guidance for good-practice of any governance approach. They merely refer to the policy-making process, 'Coherence' refers to the policy-making process and output, 'Rule of Law' to the policy output and 'Effectiveness' to the impact of a policy.

Each principle is important by itself, but good governance cannot be created using single principles alone. The application of all principles together is necessary (European Commission, 2001). On the other hand, the extensive list of principles of good governance led to the rise of the term 'Good enough governance' in development policy, stressing the need to prioritize according to the context (Grindle, 20017). Good enough governance may also be applied to successful governance of a nexus, as the list of success factors is long, as is shown in table 1 below.

Table 1. Five core principles of Good Governance according to the European Commission

Principle	Definition
Openness	Institutions should work in a transparent and understandable way for the general public. Information is freely available to stakeholders.
Participation	Wide participation of stakeholders at all levels throughout the policy chain from planning to implementation is necessary.
Accountability	Clear roles are crucial to create defined responsibilities of Member States and those involved in development and implementation of policies to make them accountable to the public and other stakeholders.
Effectiveness	Policies need to be developed to deliver effective and timely outcomes, based on evaluation of past experience and future impacts.
Coherence	Policies and actions need to be coherent and aligned both vertically and horizontally. This is increasingly important as "challenges such as climate and

	demographic change cross the boundaries of the sectorial policies on which the Union has been built" (European Commission, 2001).

Source: (European Commission, 2001)

Table 2. Additional principles for Good Governance

Principle	Definition
Legitimacy	A key factor in the effectiveness of governance arrangements. Legitimacy is "the acceptance and justification of shared rule by a community … the question of legitimacy concerns who is entitled to make rules and how authority itself is generated" (Bernstein, 2004, pp.142–143)
Rule of Law	Fair legal frameworks that are followed by all without exceptions
Fairness	All members are treated fairly in terms of cost, benefits and opportunity to participate. This also refers to the respect given to each stakeholder's views and opinions.
Capability	The right resources, skills, knowledge, systems and plans are crucial for each governance approach ability to deliver effective outcomes and impacts.
Responsiveness	The ability of institutions and processes to respond to stakeholders within a reasonable time.

Sources: (Kioe Sheng, 2009; Keping, 2018; Lockwood et al., 2010; Bernstein, 2004).

2.3 Defining nexus and successful nexus policy

The term 'nexus' has been defined in many ways in the literature. In this study we define 'a nexus' as an interconnected biophysical and socio-economic system of several interdependent sectors and each sector is equally important and addressed. The 'water-land-energy-food-climate (WLEFC) nexus' is the interconnected biophysical and socio-economic system of the WLEFC sectors and each sector is equally important and addressed. A nexus approach is defined as a way of governance that equally addresses the interests of different sectors involved and that takes the biophysical and socioeconomic connections between the sectors into consideration. Munaretto and Witmer (2017) defined the WLEFC nexus approach from a governance perspective as "a systematic process of scientific investigation and design of coherent policy goals and instruments that focuses on synergies, conflicts and related trade-offs emerging in the interactions between water, land, energy, food and climate at bio-physical, socio-economic and governance level".

Success of policy-making should be measured or judged from its impact, output and process. Impact refers to effectiveness and efficiency of the policy to reach the goals. Output refers to the quality of the developed policies; the goals, objectives implementation pathway and instruments agreed upon. The process that leads to the policy output and impact includes the whole policy cycle; the problem definition, decision-making about goals, objectives, implementation pathway and instruments, the implementation itself, monitoring and evaluation.

How can 'successful policy' be defined in a WLEFC nexus context? According to the definition of a WLEFC nexus approach, **WLEFC nexus policy output is successful if goals of all sectors involved in the WLEFC nexus, implementation pathway and instruments were defined in a transparent way, while maximising synergies between policies and instruments and managing conflicts and trade-offs at bio-physical, socio-economic, and governance level.** Managing trade-offs could mean preventing or mitigating them if possible, transparently and explicitly choosing between goals and instruments that conflict and cannot be reached or effectively applied, or reaching a compromise, taking all conflicting interests into account. Choosing between goals could imply compensation for the losers. **The process that leads to this policy**

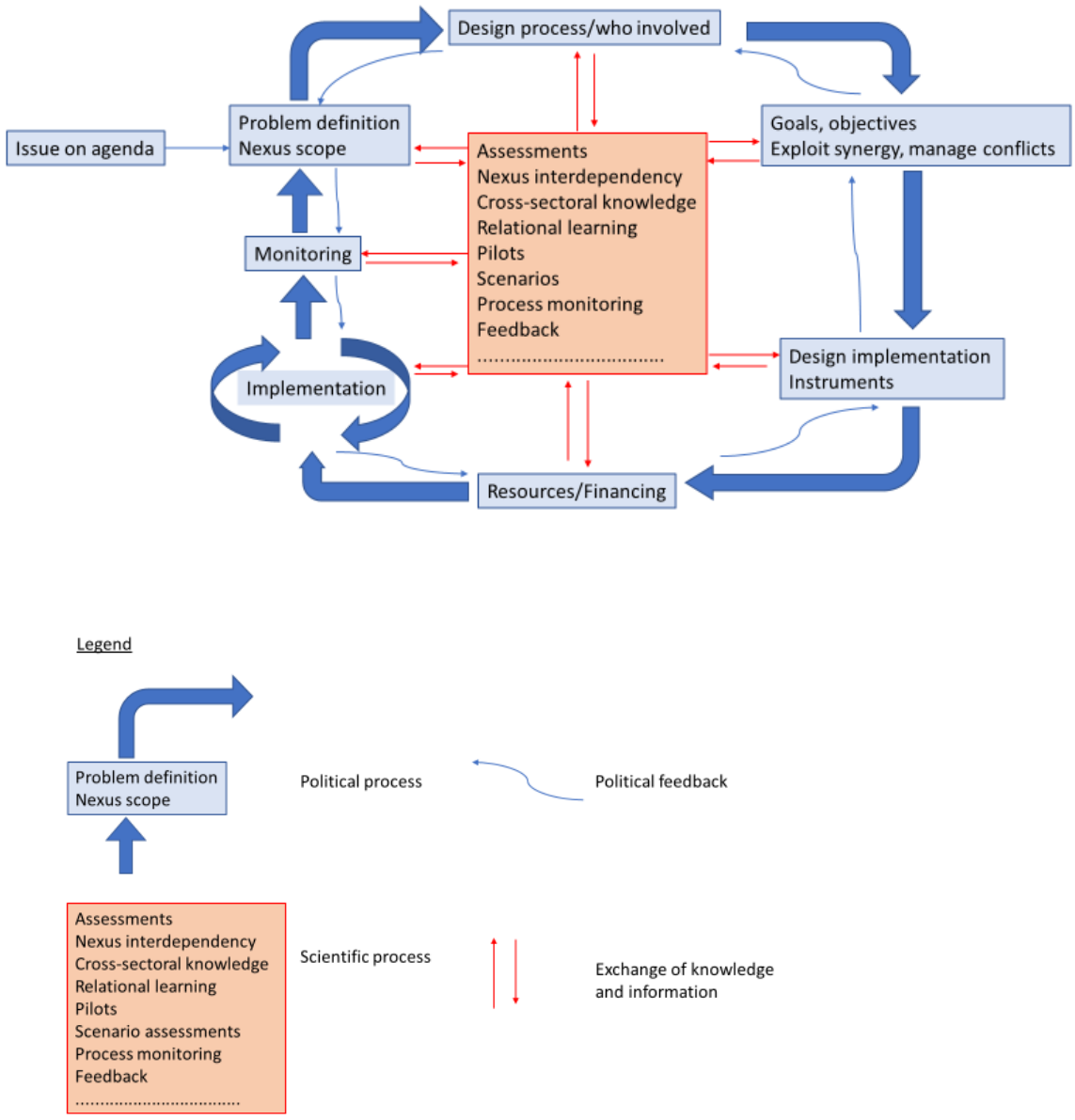
should be fair and transparent, and equally respect interests of all stakeholders involved from the WLEFC sectors. Finally, **the policy should be effective and efficient to reach the agreed WLEFC goals and be sustainable.** A nexus policy-making process is a political process, as political decisions are required at crucial moments. These **decisions should be made by actors well-informed about the relations between WLEFC sectors in the nexus at bio-physical, socio-economic, and governance level**.

2.4 Nexus governance is political by definition

All policy-making processes imply political decisions, and for a nexus approach this is even more true, as there are several sectors with different interests and goals involved, that may conflict and cause trade-offs. Even within a sector, there may be conflicting interests for different aspects. Nexus-aware decisions, based on a nexus policy-making process that is supported by knowledge about the nexus interconnections, respect the different interests and views in the nexus. Political decisions determine most phases of the policy cycle: the decision to put an issue on the political agenda with a nexus scope, the design of the policy-making process and whom to involve, the policy goals and objectives with decisions in case of conflicts and trade-offs, the design of the policy and instruments and organisation of the implementation, the resources provided for and financing of the policy-making process, implementation and monitoring (Figure 1).

Niestroy and Meuleman (2016) distinguish between political, mental and institutional 'silos'. A nexus approach should tackle all three. *Political silos* are related to the democratic process, where politicians need to win majorities. Individual politicians tend to focus on their portfolio and defend it, in order to raise their own profiles. *Mental silos* mean that people tend to believe that their problem definition and solution are not only the best, but even the only way forward. Different policy sectors like agriculture, economy and energy tend to operate in isolation (Niestroy and Meuleman, 2016). Often the less powerful sectors, such as environment and nature, that are affected by these stronger economic sectors, and integrating sectors such as spatial planning and water management, tend to have a broader scope. *Institutional silos* are the governmental and private organisations with their own culture, beliefs, rules, instruments and habits, that act like separate sectoral or functional bureaucratic entities. Niestroy and Meuleman (2016) propose to open both mental and political silos, and leave institutional silos intact, as the latter have many advantages and there is no better alternative. For the institutional silos, horizontal arrangements should be organised, according to the issues at stake and the cultural habits of the organisations. New narratives could facilitate the opening of political and mental silos and cooperation between institutional silos (Niestroy and Meuleman, 2016). As an example, they mention the narrative of presenting sustainable production and consumption as business and investment opportunities. This somehow matches the idea that was brought forward by stakeholders in the SIM4NEXUS transboundary case France-Germany, that new themes could stimulate a nexus approach. Examples of such themes are circular economy and sustainable cities. Niestroy and Meuleman (2016) recommend introducing assessments that show the synergies, conflicts and trade-offs of new policies, to provide a nexus knowledge base for integrated decisions. This knowledge will create added value to the European commission's comprehensive impact assessments which give information about the impacts of new policies on the economy, society and environment.

Figure 1. Policy cycle with a nexus approach. Implementation may be a policy cycle in itself.



2.5 Successful output of a nexus approach

A WLEFC nexus approach is considered successful if policy goals of all sectors involved are defined and considered in an equal way, while maximising synergies between policies and managing conflicts and trade-offs. In an ideal situation, nexus policies are horizontally as well as vertically coherent. Munaretto and Witmer (2017) found though a review policy documents that more synergies exist between EU policies in the WLEFC nexus than conflicts. There are also ambiguous policies, where synergy or conflict depends on the mode of implementation, and some conflicts. These general findings were confirmed in the coherence analysis by the national and regional cases in SIM4NEXUS (Munaratto et al., 2018).

At every lower administrative level where policies formulated at a higher level are translated and implemented, new interests interfere, and new interpretations of policies are developed, that may transform the original meaning of the higher-level policy. Furthermore, the closer to implementation, the more incoherence between policies becomes manifest, forcing actors to make choices. Horizontal

policy coherence at strategic level facilitates vertical policy coherence and implementation. Vague and 'wooly' formulations at strategic level, often necessary to guide different parties and interests to an agreement, may lead to conflicts in practice, when different policies are implemented at one location or by one actor. As a result, the strategic goals may not all be reached.

Table 3. Criteria for successful output of a nexus approach

OUTPUT
CROSS-SECTORAL HORIZONTAL POLICY COHERENCE
Synergies exploited
Trade-offs managed or mitigated, transparent choices made in case of conflicting instruments, objectives or goals, arrangements for losers
VERTICAL POLICY COHERENCE
Higher level policies support lower level objectives and instruments, also cross-sectoral
Lower level policies implement higher level objectives and instruments

2.6 Successful impact of a nexus approach

If policy goals are coherently formulated, exploring synergies and managing trade-offs and conflicts in a transparent way, all policy goals can be met in principle. However, complexity, uncertainty and new developments or discoveries may force actors to reconsider goals. Therefore, monitoring and evaluation are essential.

Efficiency is a criterion for good governance in general, but is more complex in a nexus, as it refers to several sectors. Optimal efficiency in a nexus may differ from optimal efficiency in each sector alone. Sustainability of a project or policy is also a general criterion for successful policy, but more critical in a nexus approach. As several sectors and possibly conflicting interests are involved, equality, inclusiveness and fairness are imperative. Because trade-offs may occur in a nexus, planetary boundaries must be observed for all sectors. In cross-sectoral situations, responsibilities and finances must be clearly agreed upon, as there is a risk of *falling between two stools*. Also, costs may weigh on one sector while another sector may profit. Several SIM4NEXUS cases stated that policy measures depended on governmental financial support and stopped when subsidies ended. Continuity is better guaranteed if projects or policies are self-supporting or generate income.

Table 4. Criteria for successful impact of a nexus approach

IMPACT
Objectives and goals met in all sectors (Effectiveness)
Cost-effectiveness/efficiency
Sustainability of project/policy
• People: legitimacy, equality, inclusiveness, fairness • Planet: environmental impacts within planetary boundaries • Profit: project/policy is self-financing or generates income

2.7 Success factors for a good nexus governance process

Table 5 shows an overview of success factors for a nexus policy-making and implementation process. The success factors are explained in detail below. Actors, authorities and administrative scales during policy-making and implementation usually differ, but this is not necessarily true.

Table 5. Success factors for a nexus governance process.

PROBLEM DEFINITION, GOALS SETTING, POLICY-MAKING AND IMPLEMENTATION
KNOWLEDGE MANAGEMENT AND RELATIONAL LEARNING
Generation and Integration of different types of information
• Understanding of interconnections between nexus sectors (biophysical, socioeconomic, governance) • Generation of cross-sectorial and cross-scale knowledge based on the understanding of interconnections between nexus sectors and of scales where influences manifest
Relational learning
• Knowledge sharing across stakeholders, sectors, governance levels • Trust between stakeholders • Understanding of diverse perspectives • Common language across different nexus sectors, common definitions • Awareness of interdependency between stakeholders
DEALING WITH UNCERTAINTY AND COMPLEXITY
Dealing with uncertainty in nexus
• Reckon with unpredictability • Integrate adaptability in planning/flexibility to change with circumstances • Allow for experimentation • Consider multiple possible scenarios for long-term governance planning, including a baseline scenario
Dealing with complexity in nexus
• Feedback loops • Time lags • Different scales
SOCIAL DYNAMICS
Cross-sectoral and cross-scale cooperation
• Do not leave issues unresolved
Leadership that builds bridges between sectors, perspectives and scales, co-leadership
Fair and equal power relations
• Inclusion of all stakeholders from all nexus sectors • Fairness among stakeholders and nexus sectors • Equal priority to all nexus sectors • Responsiveness to stakeholders of all nexus sectors
Ownership of nexus approach, commitment
• Avoid high turn-over of staff
Visioning
• Political will • Common understanding of problems, needs, solutions, goals, etc. • Political willingness to cross sectors (break silo's approach, institutions) • Social willingness (education, thinking in nexus)
Legitimacy
• Build on established framework • Authority to make decisions • Support from Government, legislation, higher authority • Inclusion/representation of all interests • Public awareness • Transparency for insiders and outsiders of process, progress, vision, goal • Accountability

• Fair rule of law
RESOURCES
Clearly and fairly-allocated financial and human resources to support the nexus approach
Long-term support for nexus policy making, implementation, monitoring and evaluation
Clear and flexible progressive implementation guidelines and clearly defined responsibilities, tasks and roles
Capability of actors to boost the change and to change own behaviour
Monitoring, evaluation and reporting
Agreed upon representative and measurable progress indicators for all goals and objectives in the nexus
Well-functioning monitoring, evaluation and reporting

2.7.1 Knowledge management and relational learning

Successfully applying a nexus approach depends initially on understanding the bio-physical and socio-economic systems that are being dealt with. Understanding the complex biophysical and socioeconomic relationships between resources at various scales is necessary to identify the most appropriate governance arrangement for a nexus (Lawford et al., 2013). This is a challenge, as methods and tools must be capable of investigating cross-sectoral dynamics between different sectors (Smajgl, 2018). As climate change and sustainability are typically "wicked problems", with contested knowledge as well as different viewpoints and opinions, the inclusion and integration of different perspectives and knowledge is important. Folke et al. (2005) argued that the knowledge required for decision making within these complex systems needs to come from a variety of actors. Because of the attributes of natural resources and their interconnections, no single stakeholder will possess full understanding of the problems a project is trying to solve. The knowledge from scientists needs to be combined with local knowledge gained through experience. This vision is confirmed by many other scholars; no stakeholder alone could provide the ultimate solution to the dynamic problems a nexus is trying to govern (Kooiman, 1993; Lockwood et al., 2010). Berkes et al. (2000) emphasized that the required knowledge to achieve sustainable resource management would come from a mix of science, local experience and indigenous knowledge. By joining stakeholders from several sectors with different background and knowledge, ideas and perspectives, a greater understanding of the problem they are facing together can be reached (Gray, 1985). Learning about complex problems can benefit from knowledge from different educational backgrounds in different sectors, with various backgrounds, roles and occupations (Bodin, 2017).

Another key component when governing environmental issues in a nexus is the capacity to find novel solutions to old problems (Westley et al., 2011). By creating collaboration between stakeholders from different nexus sectors, new thinking can be utilized. Additionally, by establishing continuous learning about the natural resources and the nexus that are being governed, a higher degree of effectiveness and adaptability can be achieved, as well as an increased feeling of ownership of the solutions for different stakeholders (Bouwen and Taillieu, 2004).

Understanding and recognizing interdependency

Bouwen and Taillieu (2004, p.147) defined interdependency among stakeholders as the "mutually negotiated and accepted way of interacting among the parties with the recognition of each other's perspective, interest, contribution and identity". In other words, interdependency consists of the agreed-upon terms of how stakeholders cooperate and make their individual skills and capacities fit together. Interdependency can also be understood as the impact of action that one stakeholder has on the ability of the others to perform their desired actions (Termeer, Breeman and Dewulf, 2010). From the definition of collaboration by Gray (1985), interdependency is understood as a precondition for collaboration between stakeholders. In a nexus approach, interdependency arises from the biophysical and socio-economic relations between the nexus sectors. It is important that the learning about interdependency takes place at multiple levels. If interdependency is recognised among stakeholders, power distribution may be reconsidered, as parties become aware that they depend on each other's actions (Walton, 1969, cited in Gray, 1985).

Sharing facts, methods, assumptions, language and framing

Combining people from a variety of sectors and disciplines could lead to misunderstanding and conflicts regarding facts. Disagreements of facts can be solved by creating joint fact-findings and cooperative science where agreements about facts can be made (Busenberg, 1999; Warner and van Buuren, 2016). This can also help different sectors and different disciplines to create a shared language and agree on unified methods to be used. Cross-sectoral cooperation requires stakeholders to develop an understanding of each other. This understanding is often hampered by different jargon, language, methods and assumptions across disciplines (Cash et al., 2003). Without this mutual understanding, knowledge and research can be hard to share and agree upon, because they will have different meanings to different sectors. The framing and reframing of a problem strongly influence the direction of the process as it gives meaning to the problem (Pahl-Wostl et al., 2007). Issue framing was defined by Dewulf et al. (2004, p.178) as "the different ways in which actors make sense of specific issues by selecting the relevant aspects, connecting them into a sensible whole, and delineating its boundaries". It has been argued that the differences in the framing of a problem is one of the fundamental reasons for miscommunication and conflict (Pahl-Wostl et al., 2007).

Through the work done in SIM4NEXUS, where many stakeholders from different backgrounds have come together, we have arrived at the conclusion that agreeing on a common language is highly important for successful collaboration in a nexus approach. We have also come to understand that this is a time-consuming task. However, without a common linguistic basis across sectors and stakeholders, the work towards the mutual goal will be tremendously hampered. Therefore, this task should be given adequate time and resources.

Trust

Another crucial component when utilizing cross-sectorial collaboration is trust between stakeholders (Renn and Schweizer, 2009; Edelenbos and van Meerkerk, 2015; Edelenbos and Klijn, 2007). Edelenbos and van Meerkerk (2015, p.26) defined trust as "a stable positive expectation that actor A has of the intentions and motives of actor B in refraining from opportunistic behaviour, even if the opportunity arise". Trust was empirically demonstrated to "increase and sustain cooperative relations and stability in relations" (Klijn, Edelenbos and Steijn, 2010, p.211). According to Renn and Schweizer (2009, p.175), trust can be created through the representation of all relevant actor groups to empower all actors to participate actively, re-design the issue in a dialogue with these different groups to generate a common understanding about the problem, potential solutions and their likely consequences. They also argued that the creation of a forum for decision making with equal and fair opportunities for all parties to take part and be heard would be necessary. In addition, it is necessary to establish the interdependency between the participatory bodies of decision making and the political implementation level (Renn and Schweizer, 2009). By achieving trust among stakeholders, they are more likely to invest their resources in collaborative and cross-disciplinary processes (Huitema et al., 2009; Edelenbos and Klijn, 2007).

The willingness to exchange information and ideas is greater when trust between stakeholders has been achieved (Edelenbos and Klijn, 2007). This will be key for the success of a nexus approach, where different sectors and different disciplines are joined to achieve a common goal. The flexibility of the approach also depends on new learning that needs to be shared among stakeholders. Trust also has the capacity to facilitate innovation. Innovation always includes some risks, but if trust is present, stakeholders will feel that everyone is putting genuine effort into finding innovative solutions and not absolving responsibility (Edelenbos and Klijn, 2007). Trust was one of the most frequently mentioned enabling factors for successful cross-sector arrangements in the ten national and regional cases of SIM4NEXUS (Munaretto et al., 2018).

If stakeholders realise the interdependencies between each other, trust is more likely to be achieved. Stakeholders need to understand the advantages of collaboration and see that the gain of cooperation is bigger than its transaction costs (Axelrod, 1984, cited in Edelenbos and Klijn, 2007). If the stakeholders

can also see the long-term gain with a cooperative relationship, the chance that it will happen is increased (Edelenbos and Klijn, 2007). On the other hand, too much trust can lead to group building with people and organisations that all think alike (Janis, 1972, cited in Edelenbos and Klijn, 2007), which does not nourish innovative thinking or equitable treatment of stakeholders.

Building trust is a long process and not something that should be rushed. It is also an ongoing process which requires constant nurturing by process management (Edelenbos and Klijn, 2007). Stakeholder expectation that there are gains to be acquired from collaboration is a favourable precondition for building trust (Axelrod, 1984, cited in Edelenbos and Klijn, 2007). A high level of transparency of the efforts and performance of individual actors together with a shared understanding of how to judge the efforts is also beneficial for trust building (Deakin and Wilkinson, 1998). Edelenbos and Klijn (2007) stressed the importance of regulation of the process, rather than the content of agreements in itself. Each governance approach will have to create its own institutional framework (conflict solutions, exit rules, etc.) to limit opportunistic behaviour that could reduce trust. The importance of agreed-upon conflict rules increases during implementation, when stakeholders become more eager to acquire the benefits generated by the project (Edelenbos and Klijn, 2007).

Trust building can take place in the form of repeated face-to-face encounters between individuals or groups. However, when this personal experience is not available or desirable, a third-party guarantor can assist in trust development (Coleman, 1990, cited in Bachmann and Inkpen, 2011). Institutions can also function as a third-party guarantor, called institutional-based trust. This kind of trust may be perceived as a weaker form of trust than the one built on personal interactions, but has similarities and is often less costly to produce (Bachmann and Inkpen, 2011). Trust based on institutions can play an important role where trust is built without the experience of former interactions between stakeholders. Additionally, at the earlier stages of cooperation and business relationship, stakeholders may feel more safe if formal arrangements such as law or certification systems exist, while trust built on face-to-face interactions will play a larger role at a later stage when information about counterparts is available (Bachmann and Inkpen, 2011).

The existence of law as a formal institute can effectively reduce the risks involved in trust, as it has the ability to align stakeholders before disagreements arise (Bachmann and Inkpen, 2011). Legal establishments help stakeholders to predict other actors' behaviour and are therefore an important mechanism for trust development. Depending on the law, it can also penalise a stakeholder that does not comply with expected performance or practice (Bachmann and Inkpen, 2011; Bachmann, 2001). However, the power of legal sanctions is not always available or appropriate. The creation of common norms and rules can have the same effect as creating laws, if the informal rules are agreed by a majority of stakeholders thereby creating legitimacy in the eyes of the actors that are expected to obey by these rules. This is more effective when the stakeholders are few, but large and well-known (Bachmann and Inkpen, 2011).

2.7.2 Dealing with uncertainty and complexity in a nexus

Uncertainty

Dealing with uncertainty in a nexus is about adaptability and experimentation. A high degree of uncertainty comes from the lack of understanding of the effect policies, governance and their outcomes have on the nexus and its resources (Nair and Howlett, 2016). Furthermore, as uncertainties are expected to increase with climate change, the ability to absorb the unexpected is going to become more important (Folke et al., 2005). Although the involvement of many stakeholders from different sectors can create new uncertainties, e.g. due to lack of understanding (Newig, Pahl-Wostl and Sigel, 2005), the nature of sustainability demands that many perspectives are taken into account.

This research adopted the definition of adaptability by Lockwood et al. (2010, p.996): "adaptability refers to a) the incorporation of new knowledge and learning into decision making and implementation; b) anticipation and management of threats, opportunities, and associated risks, and c) systematic reflection on individual, organizational, and system performance". Adaptability can be achieved by experimentation of procedures to build up knowledge about natural resources (Gerber, Wielgus and Sala, 2007; McFadden, Hiller and Tyre, 2011). Moreover, learning-by-doing on a local scale rather than experimental in the scientific sense can provide valuable insight (Olsson and Folke, 2001). Monitoring becomes crucial when trying to achieve adaptability. Without monitoring, no results can be measured, and no necessary modification can be identified. A decentralised governance structure is said to achieve a higher flexibility and adaptability (Pahl-Wostl, 1995 cited in Pahl-Wostl, 2009, p.357).

Complexity

Hand in hand with uncertainty comes complexity of the nexus. The complexity of a dynamic system that interacts on multiple levels causes short-term and long-term uncertainty (Rijke et al., 2012). Kirschke and Newig (2017) distinguished the following types of complexity: goal conflicts, variables influencing the achievements of goals, the interconnectedness of variables and informational uncertainty. In addition there are natural feedback loops, different time lags, the interconnectedness of resources and the interdependency between sectors (Kirschke and Newig, 2017). Complexity can relate to goal conflicts between stakeholders, concerning values and methods (Kirschke and Newig, 2017). Since a nexus approach is dealing with dynamic systems, a flexible management approach is required. The governance of a nexus must assure that learning is continually taking place (Bodin, 2017). Complexity also stems from contested knowledge.

Kirsche and Newig (2017) identified different governance strategies depending on what complexity is being dealt with. Complexities can be addressed by gathering information. However, knowledge may be contested and, in that case, different viewpoints must be addressed. This is important for the trust building between stakeholders, and to create cooperation. If the main complexity faced by the nexus project is conflicting goals, then conflict solving will play a role in finding a solution. Interconnection, the dynamics of variables and informational uncertainty must all be addressed by staying adaptive and flexible, especially to integrate new knowledge gained from the governance process. Interconnection and dynamics can also be addressed by using various modelling approaches such as scenario building.

2.7.3Social dynamics

Cross-sectoral cooperation

Cooperation or collaboration is defined in several ways, showing different aspects. Kinnaman and Bleich (2004, p. 311) defined collaboration as a "communication process that fosters innovation and advanced problem solving among people who are of different disciplines, band together for advanced problem solving, discern innovative solutions…, and enact change based on higher standards of care of organizational outcomes". Collaboration was defined by Gray (1985, p.912) as: "1) the pooling of appreciations and/or tangible resources, e.g. information, money, labour, etc., 2) by two or more stakeholders, 3) to solve a set of problems which neither can solve individually". Cross-sectorial cooperation is vital for a nexus approach. With many different actors and a decentralised governance focus, the most significant challenge is to ensure that coordination, direction and re-direction is present (Kemp, Parto and Gibson, 2005). Formal and informal arrangements including governance institutions, business organisations and the public must all act coherently. This underlines the importance for a nexus approach to ensure that common ground is found to steer the process, ideally with common objectives, targets and indicators.

Communication becomes extremely important when different sectors and different disciplines are trying to cooperate and linking knowledge to action. "Partnerships are relationships and are only as effective as the communication between all entities", was stated by Kinnaman and Bleich (2004, p.310).

Cash et al. (2003) found that the effectiveness of collaborations declined when communication was one-way between experts providing information, and decision makers reacting to the information. They also saw the effectiveness decline when stakeholders from either the scientific or decision-making communities felt excluded from the conversations about knowledge mobilization, as they would question the legitimacy of the information generated. Another crucial element in cross-sectorial cooperation is the ability to create a mutual language and agree on facts. Linguistic and jargon across the sectors and disciplines need to be merged.

Cross-sectoral cooperation also requires a high level of transparency, taking into account all perspectives in decision-making, setting clear rules for decision-making and providing criteria for rules of conduct (Cash et al., 2003). Cash et al. (2003) discussed the benefits of dual accountability through boundary managers. The boundary manager would relate to key actors on both the scientific side and the decision-making side. He or she would create an effective information flow and address the interests, concerns and perspectives of stakeholders on either side. This would help to increase the legitimacy of the information flow.

A well-known process model of collaboration is comprised of three phases: problem-setting, direction-setting, and structuring (Gray, 1985). The first phase incorporates the identification of stakeholders and the mutual problem they are confronted with. This is a highly important step in collaboration, as it will give the stakeholders a chance to express their perspectives on the problem. Moreover, it will also produce the core building block of the collaboration as it provides the stakeholders with a common understanding of the problem which will facilitate communication about the problem (Gray, 1985). It is also important to agree on who has a stake in an issue to emphasize the interdependency between the stakeholders, set the boundaries of the problem at stake and the governance approach. The second phase is the direction-setting phase, which is when stakeholders can start to develop a common purpose or goal. Each individual stakeholder needs to be given the opportunity to express their values that guides their opinions, and work towards finding a common ground can begin. In the third phase, a long-term governance plan needs to be created. By this stage, the stakeholders should consider each other as co-producers of the desirable change that they want to achieve (Gray, 1985).

Leadership

When dealing with dynamic systems and various sectors, flexibility, resilience and clear leadership is necessary. Folke et al. (2005) argued that leadership is essential in collaborating governance, as it must provide the necessary tools and mediate change in a dynamic environment. Leadership in collaborative governance needs to focus on generating trust, coordinating different visions and ideas, and connecting this vision with coherent action (Pahl-Wostl et al., 2007). In other words, to “support the collective finding of a clear direction in a multiparty process” (Pahl-Wostl et al., 2007, p.27). Allen and Gunderson (2011) stressed the need for leadership to drive the implementation forward. Gutiérrez et al. (2011), in their study of 130 co-managed fisheries, identified strong leadership as the most vital attribute contributing to success. Moreover, leadership has been argued to be necessary to set down clear rules, facilitate dialogue and explore mutual rewards (Ansell and Gash, 2008).

Bodin (2017) mentioned the importance of ‘boundary spanners’. A boundary spanner is an actor that takes on the role to connect stakeholders that would otherwise be disconnected, filling the structural gaps in a network (Burt, 2004). By allowing a boundary spanner to take the lead, mutual trust among stakeholders has been shown to increase (Edelenbos and van Meerkerk, 2015). Boundary spanners may also have the ability to build wide-reaching support when trying to achieve behavioural change in management and perceptions related to environmental problems (Westley et al., 2013). Leadership by central actors is suited to facilitate collective action, as they have the ability to coordinate activities, and merge ideas and practices into integrated arrangements (Westley et al., 2013; Bodin, 2017). In some governance approaches there will be a natural leader that is accepted by all stakeholders. In the absence of this natural leader a powerful stakeholder can take the responsibility (Gray, 1985). The leader needs

to be viewed as legitimate and unbiased, and he/she cannot take the leadership role to pursue their own wishes. If the governance approach is prone to conflict among stakeholders, it can be more appropriate to let a third, neutral party take the leadership. If a third party is brought into the process, it is highly important that all stakeholders consider the party to have legitimate authority to organize the approach (Gray, 1985).

Fair and equal power relations

Stakeholder involvement

For a nexus approach, involving all relevant stakeholders means including all stakeholders from all nexus sectors in the planning process. A stakeholder is understood as "an individual or group influenced by – and with an ability to significantly impact (either directly or indirectly) – the topical area of interest" (Engi and Glicken, cited in Glicken, 2000, p. 307). The inclusion of stakeholders is a way to enhance commitment, legitimacy and reduce conflicts, provide for an additional source of information and ideas, and spread awareness and knowledge (Kemp, Parto and Gibson, 2005). Fair and efficient inclusion can only take place when an on-going dialogue throughout the whole planning and implementation process takes place (Lockwood et al., 2010).

The inclusion of all relevant stakeholders in a cooperative policy-making process is argued to stimulate governability and reduce uncertainty about the acceptance and implementation of the approach (Newig, Pahl-Wostl and Sigel, 2005; Papadopoulos, 2003; Kemp, Parto and Gibson, 2005). By including all relevant stakeholders in the planning process, the likelihood that they will accept the proposed solutions increases (Delbecq, 1974, cited in Gray, 1985, Pahl-Wostl et al. 2007). The inclusion of the people who are to obey the rules in the planning process means they will take ownership of the rules and feel more responsible for them. Vink et al. (2016) argued that by involving stakeholders in the planning process and the content-creation process, it would be more likely that the content would be used by the actors in their work-practices. However, it is likely to complicate the ability of reaching fair outcomes in a time-efficient manner, and the question about power relations and respect becomes highly relevant.

Fairness and power equality

Lockwood et al. (2010) stressed the importance of fairness when trying to create successful natural resource management arrangements. Respect among stakeholders for their views needs to be accomplished, in addition to avoiding personal bias in decision-making, while paying attention to the distributed costs and benefits of these decisions for the nexus sectors. Trade-offs will most likely occur when governing a nexus, and adequate attention needs to be given to fairness, especially to make sure that losses are not borne by already disadvantaged actors (Kemp, Parto and Gibson, 2005). Power distribution can play a critical role in the nexus process as imbalances could lead to the exclusion of important problems in the interest of more powerful players (Van Bommel et al., 2009). Power inequality can also make the less powerful stakeholders feel unfairly treated and those who feel excluded from the planning process could cause resistance against plans during implementation.

Interdependence among stakeholders is important to find common ground and for the distribution of power among them. A powerful stakeholder with a low degree of interdependence may pursue his/her own goals and resist sharing his power with others (Gray, 1985). Unequal power distribution may hamper collaboration, as actors that consider themselves unable to influence the process will either pull out from the collaboration or question the outcomes of it. Moreover, powerful stakeholders may not get involved at all as they consider themselves powerful enough on their own.
In a nexus perspective, when joining many different stakeholders, power distribution may shift. The power that stakeholders previously had in their own sector may decrease when cross-sector collaboration takes place. Shifts in power distribution are important to monitor to ensure fair treatment of all parties. Loss of power may be perceived negatively and create resistance by those stakeholders who are losing it (Gray, 1985).

Equal priority to all sectors

To give equal priority to all sectors is a unique and vital feature of a nexus approach. The nexus approach has in the past been criticized by scholars for being too similar to other governance approaches, only adding a new name for the approach (Wichelns, 2017; Smajgl, Ward and Pluschke, 2016). We believe this is not true. By not giving primacy to any sector, the nexus approach is a highly important and novel approach to natural resource management. Up until now, water has often been the central point in integrated management. One of the biggest shortcomings with this approach is that people from a water-centric perspective often assume others will have the same idea about the importance and the use of water and would therefore be willing to adjust to the benefit of water policies. This assumption is flawed (de Loë and Patterson, 2017). By assigning equal importance to all sectors, a common understanding with a mutual language about the issues can be reached and innovative solutions can start to emerge (Hoff, 2011).

Ownership of nexus approach and commitment

Ownership has been defined as "a degree of involvement, commitment or engagement". Governing a nexus requires collaboration across sectors to create collective ownership of decisions (Termeer, Breeman and Dewulf, 2010). This, in other words, means the shift from thinking in an individual mode (I need, I do, etc.), to a collective mode (we need, we do, etc.). If ownership of decision and implementation can be created, it is more likely that stakeholders will be willing to reach agreements in the case of dispute and feel more committed to the outcomes created (Pahl-Wostl et al., 2007; Svensson, 2018). Additionally, ownership has the ability to increase the sustainability of the project and governance approach, as stakeholders have a sense of emotional connection to it and its outcomes (Svensson, 2018). A high staff turnover was mentioned as a hindering factor by several analysed cases (Svensson, 2018). One way to avoid loss of commitment due to a high staff turnover would be to tie the process to a lead agency or department that can support a long-term process, even if key individuals are lost along the way (Roux et al., 2008).

Visioning

If many actors are involved in the policy process, understanding each other and a common understanding of the problems are crucial. The differences in how policy goals are framed and perceived are the main challenges when dealing with cross-sectoral issues (Adelle, Pallemaerts and Chiavari, 2009). Additionally, policy coherence including coherent goals is important when dealing with a nexus, as the problems cross sectoral boarders (Candel and Biesbroek, 2016). However, oversimplification of problems and restricting possible outcomes to find shortcuts to common ground and to reach short-term solutions are not desirable. Unaddressed conflicts can remain and cause disagreements at a later stage with increased intensity (Van Bommel et al., 2009). Moss and Fichter (2003) emphasized the importance of investing time and resources to ensure common understanding and vision among stakeholders when striving for sustainable development.

Common ground can be achieved by allowing for joint information production, where experts, decision-makers and other stakeholders sit down to agree on definitions, problems, vision, etc., and create collaborative efforts or outputs, sometimes called 'boundary objects' (Cash et al., 2003). These boundary objects, if created correctly, can generate information and outcomes that are widely accepted and considered legitimate by most stakeholders.

An OECD report argued that using complexity science to understand the interconnections in natural systems is pointless unless policy makers are willing to change traditional silo policy making (OECD, 2017). Integrated solutions across sectors need to take place during the implementation as well as during the planning process. The report showed that in theory stakeholders and policy makers are prepared to bridge silos, but it rarely happens in practice. Policy integration is a long and complex process and needs political will (Kemp, Parto and Gibson, 2005).

Legitimacy

From government to governance

Legitimacy is here understood as "the state or quality that social order and authority are voluntarily recognized and obeyed" (Keping, 2018, p. 5). Lockwood et al. (2010) claimed legitimacy to be a key factor in the effectiveness of governance arrangements. Keping (2018, p.5) stated "the higher the degree of legitimacy is, the higher the level of good governance will be". Legitimacy can be earned: 1) through democratic processes, which is normally the case for governments; 2) indirectly, through regular procedures such as decision-making and appointments (Lockwood et al., 2010); or 3) at the output (Boedeltje and Cornips, 2004), for example by leadership or by generating consensus around a vision (Newman et al., 2004). Once, legitimacy could be understood merely as residing with democratically elected governments (Wallington and Lawrence, 2008). However, as cooperation between state and non-state actors becomes increasingly common, traditional roles are becoming blurred (Lockwood et al., 2010). Inclusion of a broad range of stakeholders will not only give access to information about the resources considered, but also give insight into the local acceptance of proposed measures and potentially improve the acceptance and implementation of methods agreed upon (Lockwood et al., 2010). However, the involvement of many stakeholders could mean the rise of uneven power relations (Weitz et al., 2017). Stakeholders who experience biased decisions or disrespect against them, e.g. through exclusion from the decision process, could form risks to the planning or implementation process (Van Bommel et al., 2009).

Builds on existing legal framework

Compliance with an existing legal framework also can improve legitimacy (Lockwood et al., 2010). Biermann et al. (2012) and Pahl-Wostl (2009) argued that to achieve successful adaptive governance the availability of a supporting regulatory framework is necessary.

Accountability and transparency

Accountability is argued to be crucial for the legitimacy of representative democracy (Papadopoulos, 2003) as it gives the represented the power to penalise nominated leaders if the result is dissatisfying. Accountability also refers to the "demonstration of whether and how these responsibilities have been met" (Lockwood et al., 2010, p.993). In more informal settings, accountability will be achieved through a high degree of transparency of information and process (Lockwood et al., 2010). Berger (2003) stated that only when transparency about rules, responsibility and accountability is present, true understanding of policy making in a dynamic society and environment can be accomplished. Moreover, transparency of assumptions, rules, and goals are important for the legitimacy of the process (Lockwood et al., 2010).

2.7.4 Resources

Long-term support and fairly-allocated resources

A nexus policy process is likely to need more time and resources than a sectoral approach, and the sharing of the costs may be complicated. Therefore, a nexus approach runs a high risk of ending up in a dead end. Fairly allocated resources among sectors must be available during the whole policy cycle, including the implementation and monitoring.

Lockwood et al. (2010) discussed the influence of available capabilities on the effectiveness of the implementation of natural resource management. Capabilities such as skills and leadership, competence of staff, availability of training, funding and continuity, and succession planning will all affect the ability of accomplishment.

Implementation guidelines and flexibility

When involving many different sectors that may or may not have worked together before, it is important to agree on and create clear guidelines and measureable targets. Lockwood et al. (2010) discussed how

adaptive natural resource management needs to assure systematic self-reflection of procedures, processes, and performance to make better decisions and changes to achieve their desired outcomes. Flexibility of procedures to reach objectives needs to be considered in the planning and implementation process of the nexus. As the nexus approach is dealing with complex and dynamic ecosystems and ever-changing social and ecological environments, there is a high degree of uncertainty and unpredictability. Information and understanding need to be continuously updated and adjusted, and the learning achieved during the management process needs to be fed back into the governance process (Folke et al., 2005). Objectives and goals need to be adjusted along with the new understanding achieved throughout the implementation and monitoring process. It is also important that policies are adapted to the spatial scales of implementation (Liu et al., 2007). Moreover, adaptation of interventions at regional and local scales may be necessary to maximize the adaptive capacity (Dressel, Ericsson and Sandström, 2018).

The planning process should be followed by the implementation of the management plans and rules decided upon. This can seem obvious, but implementation does not always take place. Allen and Gunderson (2011) discussed how adaptive management programmes got stuck in 'planning loops' in the pursuit of perfection and success rather than going through the phase of experimentation. Unclear responsibilities and dependencies were argued by Vink (2015, cited in Roth et al., 2017, p.59) to lead to a 'vicious circle of non-decision making'. A stakeholder of the France-Germany transboundary case of SIM4NEXUS mentioned that some articles of a French biodiversity law of 2016 were never implemented or bypassed, apparently due to the low priority afforded to them by the authorities that had to implement them.

2.7.5 Monitoring and evaluation

Without quantifiable and measurable indicators, improvements and compliance are hard to measure and it is difficult to advise management decisions (Benson and Stephenson, 2018). The process of indicator development is also a suitable way for stakeholders to agree on what is important, and an efficient way to spread knowledge and empowerment (Kemp, Parto and Gibson, 2005). An agreement must be reached about responsibilities and financing for the monitoring and evaluation. The importance of monitoring was confirmed by the SIM4NEXUS national case Latvia, where budget-cuts in monitoring led to a lack of information and unwillingness of parties to accept new measures in water management.

3. Success factors in eight multi-sectoral cases

This chapter summarizes the work by Svensson (2018), who analysed success factors in the governance of the water-land-energy-food-climate (WLEFC) nexus for her master thesis, contributing to SIM4NEXUS.

3.1 Selection of cases

Svensson (2018) searched scientific and grey literature for suitable cases that provided quantitative evidence of successful management of natural resources. Cases should meet the following criteria:

- Nexus characteristics in the governance approach
- Implemented and evaluated
- Considered fully or partially successful by the author
- Provided enough details to be analysed.

Effort was made to get a complete picture of the planning and implementation processes. Eight cases with 27 documents were selected, from different countries worldwide with different management approaches (Table 6). There were no explicitly termed 'nexus' projects that met the criteria. Most documents with an explicit nexus focus were either projects not yet implemented or had not been running long enough to determine success or failure. See Svensson (2018) for more details about the cases, the selection method and the analysis.

Table 6. Cases selected for the analysis of success factors in a nexus approach (Svensson, 2018).

Project Title	The CALFED Bay-Delta Program	Canterbury Water Management Strategy	Payment for Environmental Services Scheme in Naivasha Basin	Nam Ngum River Basin Development Sector Project
Abbreviation	CALFED	CWMS	Lake Naivasha	NNRB
Country	USA	New Zealand	Kenya	Lao People's Democratic Republic
Duration of project	1995-2010	1998 - On-going	2008 - 2011	2002-2015
Project Objectives	The CALFED Bay-Delta program was established to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system.	To enable present and future generations to gain the greatest social, economic, recreational and cultural benefits from our water resources within an environmentally sustainable framework.	To improve the livelihoods of households in the Malewa Catchment area by introducing Payment for Watershed Service, with the aim to improve water quality, secure livelihoods and habitats for biodiversity and sustainable economic development.	To support integrated water resource management, to reduce poverty and promote sustainable economic growth
Nexus Characteristics	The Program addressing four problem areas, which are all, interrelated. The ROD stated "all aspects of the CALFED Program are interrelated and interdependent" (CALFED Bay-Delta Program, 2000, p.4). The Program stresses that objectives will not be met by individual actions but rather in conjunction with other CALFED actions.	The targets are to be addressed simultaneously, with a holistic view. The Strategy is a leadership document, with the intention to lead dynamic water management with an experimental nature.	The project addresses water issues by improving land management, while at the same time incorporating social development in terms of improved livelihood and the protection of biodiversity. The interrelation between water quality and land management is emphasized and shared among the communities.	Economic growth, environmental management and natural-resource conservation was given cross-sector priorities, and "implementation arrangements attempted to address several issues simultaneously" (Asian Development Bank, 2016).

Project Title	Integrated Marine and Coastal Resources Management Project	Guangxi Integrated Forestry Development and Conservation Project	UN Joint Programme of Environment Mainstreaming and Adaptation to Climate Change	Private Sector Renewable Energy and Energy Efficiency Project
Abbreviation	Senegal	Guangxi Zhuang	Mozambique	Republic of Turkey
Country	Senegal	People's Republic of China	Mozambique	Turkey
Duration of project	2005-2012	2007-2012	2008-2012	2009-2016
Project Objectives	To empower coastal communities to take concrete actions to reduce conditions of open access and thus overfishing, and protect sensitive coastal environments and its biodiversity.	To improve the effectiveness of forest management and institutional arrangements in timber production, watershed protection and nature reserves management ins selected areas of the Guangxi Zhuang Autonomous Region	Integrate environment and climate change aspects into government plans, policies and strategies at different levels and to improve the resilience of rural communities to climate change by improving and strengthening management of the natural resource base and diversifying livelihoods	To help increase privately owned and operated energy production from indigenous renewable sources within the market-based framework of the Turkish Electricity Market Law, enhance energy efficiency, and thereby help reduce greenhouse gas emissions.
Nexus Characteristics	The project addressed the often conflicting priorities of conservation and fishing exploitation by protecting habitats on coastal land and water that the fish stock depends on, and create local co-management to reduce over-fishing.	The project focus on optimizing the timber industry by taking into account the ecological aspect, protecting biodiversity, land and water, while at the same time achieve carbon sequestration and increase the income of local communities	The project covered a wide range of sectors and activities, such as water access, increase and diversification of agricultural and livestock production, income generation, natural resource management and use of renewable energies	The project focused on increasing renewable energy production in the private sector to decrease unemployment rate, while at the same time decrease greenhouse gas emissions and increase energy security

3.2 Success factors in the eight selected cases

The results of the analysis by Svensson (2018) are summarized in Table 7.

Table 7. Success factors and issues mentioned in the eight selected multi-sectoral cases (Svensson, 2018).

KNOWLEDGE MANAGEMENT
Generation and Integration of different types of information
• Scientific information was mentioned in all cases. • Six cases mentioned a baseline study in the pre-planning phase. • Technical information and professional knowledge were important.
Relational learning
• All cases mentioned knowledge sharing
Dealing with uncertainty in nexus
• Five cases used scenario building.
Dealing with complexity in nexus
• Not addressed by analysis or not mentioned by the cases.
SOCIAL DYNAMICS
Cross-sectoral and cross-scale cooperation
• Unresolved issues.
Leadership that builds bridges between sectors, perspectives and scales
• Subsidiarity was mentioned in six cases. • Seven cases used regional or local leadership.
Fair and equal power relations
• Six cases mentioned fairness. • All cases involved one or more stakeholder groups. • Seven cases involved local communities. • Six cases mentioned 'public inclusion'.
Ownership of nexus approach, commitment
• Six cases mentioned ownership.
Visioning
• Six cases mentioned common understanding or common vision. • Seven cases mentioned political or social willingness.
Legitimacy
• Seven cases mentioned public awareness. • Seven cases mentioned government support. • Four cases mentioned stakeholder support and public acceptance. • Authority was mentioned in all cases • Building on an existing framework was mentioned by six cases. • Transparency was mentioned in three cases.
RESOURCES
Clearly and fairly-allocated financial and human resources to support the nexus approach
• Financial support was important for all cases. • Lack of finances. • High staff turnover.
Long-term support for nexus policy making, implementation, monitoring and evaluation
• Long-term management and technical support were mentioned in six cases.
Clear and flexible progressive implementation guidelines and clearly defined responsibilities, tasks and roles
• In seven cases objectives and indicators were revised during the project. • All cases mentioned adaptability and quick response to changing conditions. • Clear guidelines and measurable targets were mentioned by seven cases.

• Unclear guidelines or direction.
Capability of actors to boost the change and to change own behaviour • All cases performed capacity building.
Monitoring, evaluation and reporting
Agreed upon representative and measurable progress indicators for all goals and objectives in the nexus • Measurable targets were mentioned by seven cases.
Well-functioning monitoring, evaluation and reporting • All cases mentioned monitoring, to ensure adaptability and maintain confidence and trust.

3.3 Conclusions

Svensson (2018) identified fifteen critical elements that increase the likelihood of a nexus project being successful:

1. A strong scientific baseline is the ideal start

This should be given sufficient time, as a thorough understanding of the interconnections between resources and sectors is crucial. Moreover, no improvements can be measured without setting the baseline.

2. Scenario building can increase awareness and prepare for uncertainties

A nexus approach deals with many uncertainties, and scenario building has been shown to be an efficient way to increase the awareness of issues and prepare stakeholders for uncertainties, making the project more resilient.

3. Plan for adaptability and allow for objectives and targets to be revised to keep them relevant

Adaptability needs to be acknowledged already in the planning phase to prepare stakeholders and players that change may happen along the way. Revision of targets or methods to incorporate change will most likely be necessary, because governing a nexus involves many uncertainties.

4. Involve stakeholders in every aspect of the project

For a nexus approach, involving stakeholders from all relevant sectors is crucial. Involving local communities can be an efficient way to get information about local policies, cultures and knowledge, and avoid conflicts. Involvement can also increase ownership.

5. Dynamic knowledge sharing and capacity building are important

The exchange of knowledge is important for the innovation of the project, the equity of participation and the achievement of goals. As knowledge may be contested, it is important that parties are open to different interpretations and framings of knowledge. Specific for a nexus, involving many sectors means that learning about new methods, languages and jargons will be necessary. It is also important to raise awareness about issues in different sectors that might not be known by stakeholders in other sectors.

6. A fair distribution of costs and benefits needs to be achieved, and equal opportunity to participate in the project for stakeholders

If the opportunity to participate for stakeholders in all sectors and the outcome of the project are considered fair, implementation of the project may be reached with higher acceptance.

7. Ownership increases engagement and sustainability of project

Creating ownership of the project can increase the likelihood of it being sustained in the future. A high staff turnover should be avoided to minimise the loss of information, legitimacy and emotional connection with the project.

8. Political and social willingness to change facilitate the implementation of project

The political and social willingness to change is important since it can help to push the change forward. An unaccepted status quo can make stakeholders more receptive for proposed changes.

9. Public Awareness increases acceptability and knowledge

By increasing public awareness, the need for change may be clarified and the proposed actions more likely to be accepted.

10. Common understanding and common vision need to be achieved

The effort to find common ground among stakeholders should not be rushed, as this vision will help steer the process. By the nature of a nexus, this will be extremely important as combining stakeholders from many sectors could mean divided ambitions that need to be merged. If a shared vision is reached, players will have higher acceptance towards short-term inconveniences for the benefit of the shared vision. Moreover, if a true understanding of each other's interests is achieved, stakeholders from one sector may be more open to solutions which are beneficial for another sector.

11. Legitimacy is essential

Legitimacy helps to gain support for the project. Recognised authority to implement change is important as empty promises quickly deplete trust. Building on already existing frameworks and establishments can help the project to gain legitimacy.

12. Clear guidelines and measurable targets to avoid incoherent implementation

Clear guidelines will avoid misunderstanding and without measurable targets, monitoring is problematic. This becomes especially important when many sectors with different backgrounds and understandings are working towards a common goal.

13. Monitoring is important for developing a shared understanding, building trust, adaptability of the project and enforcement

Monitoring the projects process is fundamental for its success. Without monitoring, no progress can be measured. Monitoring is also important to provide information for future planning, to raise awareness, to assure trust among stakeholders is upheld and for the enforcement of the project.

14. Scale of governance should match the problem scale

Subsidiarity is an important criterion to divide the decision and implementation power. Decision and implementation power should be awarded to the most local level possible, to assure that correct information is used, to create ownership and acceptance and to avoid conflicts with local or regional plans and regulations. Regional or national leadership should be used when local leadership does not have sufficient capacity. Leadership that is too distant from the issue may overlook problems, synergy options and trade-offs.

15. Long-term support is necessary

Access to the right resources, such as finances and a long-term management plan that allows for flexibility, is crucial for the successful completion of the project.

4. Success stories told by the SIM4NEXUS regional, national and transboundary cases

4.1 Introduction

The ten cases of SIM4NEXUS at regional, national and transboundary scale made an inventory of institutional arrangements for cross-sectoral cooperation in the water-land-energy-food-climate nexus and success factors for these arrangements. They got their information from literature, stakeholder workshops and interviews. These success factors were added to the Framework for successful nexus governance, described in Chapter 2, if they were not already mentioned there. The SIM4NEXUS cases were asked to verify the Framework and give examples of the success factors from practice in their cases. The results are listed in Tables 8 and 9. Finally, cases were asked to specify in more detail some of the issues that they brought forward, to give deeper insight into the approaches, and their success and failures. They were asked if they knew any multi-sectoral policies or projects in their area that already had been implemented and evaluated, so that the success of output and impact could be judged, and lessons learned from success factors in the process that led to these outputs and impacts. Also, they were asked how these successes were achieved. Finally, they were asked to give examples of 'innovative practices' in policy making and implementation in multi-sectoral, integrated system approaches.

4.2 General observations

The cases delivered examples at transboundary, national and regional scales. None of the examples demonstrated the complete water-land-energy-food-climate (WLEFC) nexus. Apparently, this is beyond the scope, competence and scale of current governance institutions. Issues and problems were defined from own viewpoints and scope, and cases indicated that organisations were not always aware of interdependencies, synergies and trade-offs related to other sectors. Typically, one of the nexus sectors is a point of departure, and relations with other sectors are investigated and considered from that central viewpoint. Examples are the International Commission for the Protection of the Rhine, the protection of biodiversity and wetlands in Greece and the climate policy in the Netherlands. It seems that more powerful, driving sectors, such as economy, energy, forestry and agriculture, tend to have less eye for nexus relations and trade-offs than less powerful and affected sectors such as water management and nature protection. Broader scopes are to be found in integrating policy fields such as rural development and spatial planning. Also, the rise of new integrating topics was mentioned as stimulus for nexus approaches. Examples are Sustainable Development, Cities, Soils, Food Autonomy, Health, Mobility and Circular Economy.

Being successful in a nexus approach has many dimensions and is multi scale. All success factors mentioned in the Framework for successful nexus governance were addressed by the cases, but none of the cases mentioned them all. Success factors are interdependent, for example a flexible pathway needs an effective monitoring and feedback system, exchange of knowledge needs close cooperation and long-lasting cooperation and monitoring need long-lasting funding. That a nexus approach can be multi-scale is demonstrated by the Czech-Slovak case. Global and European climate and energy policies led to national subsidies for the growth of bio-energy crops. Large-scale monoculture of bio-energy crops has changed the landscape and hydrology, and caused regional climate change, heat and drought. Solutions can be found at European scale, the phasing out of 1st generation biofuel crops produced from food and feed, national scale, adding environmental conditions to the subsidy of bio-energy crops and financing landscape restoration, and at regional and local scales, convincing land owners and farmers that they should restore natural elements in the landscape.

4.3 Success factors addressed

4.3.1 Knowledge

If there are common interests and goals, knowledge is shared between sectors in formal and informal settings at national, regional and local scales. Lack of knowledge about trade-offs can lead to failure of policies, knowledge sharing to success, as was evidenced by France-Germany, Andalusia and South-West England. Well-structured and transparent environmental impact assessment (EIA) that includes an analysis of coherence of policies, was suggested as a success factor by Sardinia.

Building of trust and shared visions seem to be essential but takes a lot of effort, time and energy. Trust, common understanding and language are built over years (Greece, Sweden, South-West England). Among farmers, informal networks at local scale seem to be more important for information exchange than formal meetings, which farmers might not have time to attend. Examples of good practice were found to be convincing for farmers to participate in programmes for catchment sensitive farming (South-West England). In Latvia and the Czech Republic, free information sharing has been organised for private parties. Innovative forms of relational learning are regional 'Living labs' (Latvia), 'EIP-AGRI (European Innovation Partnership for Agricultural productivity and Sustainability) operational groups' (Andalusia) and 'Climate tables' (The Netherlands).

The lack of knowledge about the real price of production, in terms of overall costs for people, planet as well as economy, was felt as a hindrance for well-informed decision making about the use of natural resources (France-Germany).

Uncertainty leads to a dilemma in policy-making. On the one hand, policy making in an uncertain context demands a flexible approach with pilots, learning by doing, and adjustments of strategies according to findings. On the other hand, actors who implement the policies need clear instructions and continuity to invest in new methods and innovations, but fixed legislation may hinder innovations. Only in close cooperation between policy makers and parties who act on these policies, can progress be made. It seems unavoidable that new insights lead to change of strategies, and there will always be parties affected by the change. Integrated assessments and scenario studies that identify possible alternatives may minimise these negative consequences. If interdependencies are well considered, trade-offs may be avoided, mitigated or compensated. A system of monitoring, evaluation and feedback is indispensable for flexibility.

Transboundary cooperation adds to complexity, but on the other hand there are institutions and financing options created especially for transboundary cooperation, which also take care of cross-sectoral issues, such as the Upper Rhine Conference. This long-existing institution has created shared knowledge and trust. There are European funds for transboundary cooperation, but the France-Germany case mentioned that these are underspent because stakeholders do not know they are eligible and application processes are too complex.

4.3.2 Social dynamics

'Who is in charge of the nexus?' This question was raised in the France-Germany case. Usually, sectoral authorities tend to support their own remit and goals. The more parties from different sectors are involved, the less responsibilities are clear. Shared goals and visions are essential for cross-sectoral cooperation and determine the scope of a nexus approach. Cross-sectoral cooperation is a choice, weighing the benefits against the investments in time, energy, capacity and resources. Cross-sectoral cooperation also means giving up power to reach a shared vision. Cooperation seems easier between parties with relatively equal power and reciprocal interdependency, for example between a ministry and electricity company in Greece. Lack of power may hinder cross-sectoral cooperation, as was shown by the Water Framework Directive (WFD) units in Sweden. Sweden also showed that the structure of

an organisation can determine ease of cooperation. An example of this is a centrally supported collaboration organisation that supports cooperation between different counties (RUS: Regional development and cooperation in the environmental objectives system), which is different from interdependently working parallel units, as is the case with the independent WFD units. If cross-sectoral cooperation is not institutionalised, it may collapse as soon as the impetus is lost; for example a leader changes jobs, or a subsidy stops. Individual and institutional leadership and commitment were mentioned as important factors for creating successful cross-sectoral cooperation by Sweden, the Czech Republic, Andalusia, France-Germany and The Netherlands. Cooperation can also be 'over arranged', when several networks overlap in responsibilities and tasks (France-Germany).

4.3.3 Legitimacy

Legitimacy is gained by bottom-up input, collaboration, participation and co-creation. Transparency and quick responses by the government were both forwarded as important conditions to gain support by the general public (South-West England, Sweden). The 'Climate tables' in The Netherlands that discuss measures to reach climate goals in 2030 build on an existing framework, a climate agreement between stakeholder groups and the national government to reach climate goals in 2020. If the government initiates a process that demands effort and input from actors and creates expectations, this should not be stopped or postponed without good reason, as this is fatal for trust, enthusiasm and support (The Netherlands). Public awareness is thought to be an important success factor for reaching goals. It can be increased by investing in education, according to the cases Sweden, France-Germany and Czech Republic.

4.3.4 Resources

EU and national funding, such as Regional rural development and coherence funding, are often mentioned as a condition for successful cross-sectoral cooperation at national and regional scale. However, conservatism in agricultural financial support may hamper innovation (France-Germany). EU Interreg funds can be mobilised in transboundary regions, such as the Upper Rhine and the Dutch province of Noord-Brabant and the Belgian province of Antwerp. National budget cuts for monitoring led to loss of support for new measures in water management in Latvia. Private financing was mentioned by Greece (banks) and by Sardinia. In Sardinia entrepreneurs are waiting for occasions to pick-up challenges.

4.3.5 Monitoring

The Netherlands intends to integrate the monitoring of the SDGs into the 'National Prosperity Monitor'. Fragmented monitoring can hamper policy-making because lack of trust in the effectivity of measures. All stakeholders highlighted the need for shared and trusted information across sectors in Sardinia.

4.3.6 Horizontal and vertical coherence

Cases investigated the horizontal and vertical coherence of water-land-energy-food-climate (WLEFC) policies (Munaretto et al., 2018). They concluded that most WLEFC policies were horizontally coherent. Exceptions include conflicts between objectives for water, land, agriculture and energy production caused by competition for scarce land and water. Another example is that opportunities to create synergy with land, water and nature management and forestry are not exploited, because technical instead of nature-based solutions are chosen for climate change adaptation and combatting floods and droughts.

Vertical coherence may depend on the horizontal coherence of strategic policy at a higher level. For example, water quality goals at regional scale in the Netherlands cannot be met because there is incoherence between water quality and agriculture policy at national scale.

Stakeholders in the France-Germany case raised the question 'What is the right scale for the nexus? If too small, the authority can encompass all nexus domains but has little means to implement ambitious changes. If too big, the authority must split its policies into domains and there are communication and cooperation issues between services, and conflicting priorities'. As policies at different scales are connected, and the division of competences across administration levels differ per sector, the right answer seems to be that a nexus approach should cover several scales according to the issues at stake, and cooperation and communication must be organised cross-scale as well as cross-sectoral.

4.3.7 Impact

Cases gave little information on impact. Rural development programmes have been successful in Andalusia, as it served water, agriculture and land objectives, as well as sustainability aspects employment (people), economy (profit) and environment (planet). Agriculture was criticised in the national and OECD SDGs monitor for being unsustainable in the Netherlands.

4.4 Success and failure in the cases

4.4.1 Greece: Success in cooperation and shared vision

Trust was achieved through discussions and compromises made by the involved parties in each arrangement. Also, common goals and interests led to the creation of trustworthy synergies among several stakeholders. Discussions support the exchange of knowledge, the clarification of misunderstandings, the "smoothing" of conflicts and thus the creation of trust.

Energy and Climate. HPPC is the biggest energy provider in Greece. The Ministry of Environment and Energy is the main decision/policy maker on issues concerning the management of energy resources, energy production and energy consumption patterns in Greece. So, these are two stakeholders with common interests and goals. A primary goal of the Ministry of Environment and Energy is the adoption of RES for energy production. HPPC manages power plants that produce electricity by using coal and gains profits by selling the produced electricity. At this point, a conflict arises but a compromise solution has also been found. HPPC places emphasis on electricity production from RES besides coal. As a result, it has founded a subsidiary 'HPPC-RES' which occupies 20 wind parks, 17 small hydro-electric power plants and 28 photovoltaic parks that produce electricity from RES. On the other hand, while it is still impossible to cover the whole energy demand through the exploitation of RES, the Ministry of Environment and Energy allows the use of Greek coal stocks for electricity production (but with reduced rates). Also, trade-offs contribute to the achievement of compromise decisions.

Water-Agriculture. Current efforts in Greece are focusing on the reduction of water losses and the protection of water quality. Emphasis is put on the renovation of irrigation systems for limiting water losses as well as on the protection of water quality from pesticides and fertilizers.

4.4.2 Latvia: Free knowledge sharing in good cooperation about forestry; fragmented monitoring

Environmental NGOs (e.g., "Pasaules Dabas Fonds", "Latvian Fund for Nature") in cooperation with Forestry consulting service Ltd. are organising free of charge informative seminars for various stakeholders (e.g., land, forest owners) in environmentally friendly forest and land management. These events are aimed at educating land and forest owners on finding a balance between nature conservation and economic interests. Good practice examples of sustainable forest / land management are promoted during these events, highlighting practical approaches and benefits from sustainable land/forest management.

National legislation (Cabinet of Ministers Regulation) defines competent authorities/institutions for data collection and indicators for monitoring. The Central Statistical Bureau of Latvia is responsible for national statistics while the Cross-Sectoral Coordination Centre Republic of Latvia is responsible for monitoring the national development planning documents, and implementation of such documents. This institution performs analytical tasks assigned by the Prime Minister and Prime Minister`s Office and monitors implementation of sectoral policies. In practice implementation of monitoring programmes requires financial support. During the financial crisis (2009 – 2012) the available funding for monitoring programmes was reduced substantially. It affected particularly surface water monitoring, resulting in fragmented data. Re-instalment of monitoring programs to their full extent is time consuming.

Currently (2018-2019) the University of Latvia is developing a system model for environmental indicators at national, regional and local level. It is assumed that cross-sectoral aspects will be covered.

The Strategy for Low Carbon Development until 2050 is under development. One of the key success factors is related to efficient management of resources, e.g. water, forest, agricultural land, in line with the principles of circular economy, bio-economy and low carbon development. This is to be achieved by unpacking the potential of synergies and managing trade-offs between sectoral and climate policies. Examples of efficient management practices in Latvia can be attributed to the country's capacity to ensure local agricultural resources for food production and consumption as well as an increased amount of wood stock.

4.4.3 Sweden: Successful nexus approach has many dimensions

To support nexus-oriented policies, strategies or work, one needs to support many different dimensions: from political/legislative, through knowledge, data and resources, to creating motivation and incentives. There are many factors of success in cross-sectoral arrangements, which can be linked to both individuals and organisations. Examples of the former are committed individuals, presence of leaders, personal contacts and relevant knowledge available, right motivation and incentives. Examples of organisational aspects are a supportive environment, supportive legislation and existing routines, practical arrangements that enable work and availability of resources. There can be many ways of sharing knowledge across sectors, both formal and informal. Formal arrangements are e.g. networking initiatives such as 'Regional development and cooperation in the environmental objectives system (RUS)', participation of actors from different sectors in common projects, e.g. LIFE funded, participation in conferences or seminars under a common theme. But there can also be many local arrangements, e.g. when actors from different sectors work locally on a specific issue, e.g. water management. Also, there are local projects, e.g. LONA: local conservation projects, habitat restoration or water management projects.

To achieve a shared vision, common interests and goals, there is a long tradition in Sweden of deliberative processes and participation. In general, a decision-making process that aims at creating a common vision and goals involves many different stakeholders and a long process of consultation, participation and deliberation. Trust building is very important which often happens in both formal and informal settings.

'Regional development and cooperation in the environmental objectives system (RUS)' is more successful in cross-sectoral cooperation than the implementation of the WFD. The reason is that RUS is one unit that connects different authorities, particularly County boards and the different sector-units included in these boards. It has a transparent structure and a working group that is leading and organising all the work, including collaboration. In the case of the WFD, the structure is different. There are five key units - Water Authorities, that work independently of each other and have independent responsibilities. These units collaborate, but not under a common structure. The key issue, however, is that Water Authorities do not have legislative power to compel other sectors to do anything. For

example, the forestry sector is relatively independent and can work with water related questions on its own. So, collaboration depends on good will and committed individuals.

How can environmental aspects be further incorporated in education, to raise public awareness? In general, schools and higher education institutions in Sweden have developed a wide range of curricula to meet the objectives of Sweden's environmental policy. Environmental education in primary and secondary schools is taught primarily through biological sciences and social studies. However, the Swedish Education Act, which ensures that all children and students have access to the same free-of-charge high-quality education, makes it difficult to conduct field trips as official parts of their education. The main reason is that parents cannot be charged with additional travel costs, because the education system is free of charge by law. The aspiration is to provide more funding to municipalities and public schools to organize field trips for children, which in the long run could lead to multi-disciplinary education and a future society that is aware of environmental aspects and their links and feedback mechanisms to different sectors.

4.4.4 The Netherlands: Long-term stakeholder engagement

The Dutch national government has engaged stakeholders in the policy process for a long time to tackle WLEFC nexus issues, although they have never been labelled as a nexus. Stakeholder engagement has been used to address and solve conflicts, negotiate trade-offs and exploit synergies in practice. In 2011, an inventory of conflicting interests in the bio-based economy was made and assessed how to deal with them. This assessment resulted in an overview of how the government could act regarding these challenges. Communication appeared to be crucial, as some conflicts stemmed from misunderstanding. For example, the business community complained about overly strict rules that they experienced as obstacles against innovations. The government made clear that such rules were made for good reasons, such as public safety, and could not be relaxed. Some measures were out of reach of the government, as they concerned market issues for businesses to handle. This way of working on obstacles and conflicting interests increased clarity and led to follow-ups, such as the 'Transition House and Front Runner Office'.

Many of the obstacles that were picked up by the national government were related to procedures, administration and legal definitions. For such obstacles, a new arrangement was installed, the 'Acceleration Team', where market parties are signalling issues to the Programme Department for Bio-based Economy. This has led to shorter procedures and improvements in the subsidy scheme for Stimulation of Sustainable Energy Production (SDE+). In 2016, a National Agreement on the Circular Economy was, signed by 180 organizations which led to a Transition Agenda Circular Economy.

4.4.5 Azerbaijan: International support is important success factor

The stakeholders of the Azerbaijan case provided examples of successful cooperation in policy-making, implementation and projects in the WLEFC nexus in Azerbaijan. This cooperation happened between public parties, between public and private parties and between national and international parties within nexus sectors, but not cross-sectoral. However, within the agricultural sector, water-use, sustainable land-use, production of biogas from agricultural residues and GHG emissions were addressed. Support from international parties seems an important success factor, as they were often mentioned. International relational learning is occurring in the development of renewable energy. Transboundary cooperation is stimulated in the water sector. In the context of UNFCCC obligations, and the development of an energy market, capacity building was mentioned as success factor.

Water

Azerbaijan receives twice as much fresh surface water from catchments outside than inside its borders. Transboundary water management is stimulated in the context of the UN Economic Commission for Europe (UNECE), the United Nations Convention on the Protection and Use of Transboundary Watercourses, and the International Lakes and the Water and Health Protocols of this convention. As a party to the convention, Azerbaijan is actively cooperating to achieve the convention goals. The strategy is based on international water law and the EU Water Framework Directive (WFD). The German Development Bank (KfW) cooperates with local Open Joint-Stock Companies to improve the water supply and sewage systems.

Land

The Institute of Soil Science and Agrochemistry of the Azerbaijan National Academy of Sciences (ANAS) and Seoul National University of the Republic of Korea signed a cooperation agreement to conduct joint scientific research in the fields of soil science, ecology, agrochemistry and land reclamation, recultivation and protection. They have opened an International Laboratory of Soil Ecology.

Environment

In 2003, two national programmes were developed, "Ecologically sustainable socio-economic development" and “Restoration and increase of forests". There is also a project named "Improvement of the Methodological Toolkit for Environmental Impact Assessment in Transboundary Context in the Caspian Region". Funded by UNEP and the TACIS programme of the European Commission (Technical Assistance to the Commonwealth of Independent States), a ‘National Biosafety’ project was developed, as well as a National Action Plan on Environmental Protection and Assistance in the Implementation of Environmental Policy, within the framework of the Caspian Ecological Program.

Energy

Azerbaijan's energy system consists of 13 Heat Power Stations and 8 Hydro Power Stations. The Ministry of Energy cooperates with the state-run fuel and energy companies, as well as central and local executive authorities, local self-governance bodies and non-governmental organizations. The Strategic Road Map on the Development of Communal Services (Electricity and Heat Energy, Water and Gas) has been ratified. The measures envisaged by this Road Map are implemented by the Ministry of Energy together with relevant executive bodies. The Ministry is taking steps to ensure the participation of international companies in the commissioning of new production capacities. The Ministry implements pilot projects to strengthen the use of renewable energy sources and to learn from international experience. In addition, the Ministry appealed to the Republic of Azerbaijan for the establishment of cooperation between the Republic of Azerbaijan and the Eastern European Partnership Foundation for Energy Efficiency and Environment (E5P).

The Ministry of Energy has submitted a draft law on the new "Electricity Generation", which includes the activities of the electricity market, involving experienced and local experts within the Low Voltage Empowerment Capacity Building Strategy implemented by the US Agency for International Development (USAID). The Ministry of Energy and BP are collaborating to improve the operation of small hydroelectric power stations and to effectively utilize the hydro-electric potential of rivers.

Agriculture

The project ‘Assistance in the creation of farming information and monitoring systems’ was implemented in cooperation with the Ministry of Agriculture and FAO.

Agriculture <> Water

The ‘Azersu’ Open Joint-Stock Company cooperated with the Institute of Soil Science and Agrochemistry and Genetic Resources Institute of ANAS to study the relation between coffee production and water supply.

Agriculture <> Land

The Ministry of Agriculture cooperated with ANAS to study agricultural land use. The project on promoting sustainable land use was effectively implemented. State Programmes on "Efficient Use of Summer-Winter Pastures, Harvesting and Desertification Prevention" and "Development of Hydrometeorology in the Republic of Azerbaijan" have been approved and implemented.

Agriculture <> Energy

The State Agency on Alternative and Renewable Energy Sources (ABEMDA), a governmental agency under the Ministry of Industry and Energy, is currently building biogas plants. The Ministry of Ecology and Natural Resources has commissioned small-scale biogas plants.

Agriculture <> Climate

The agricultural sector is a source of GHG emissions and one of the target sectors of climate policy.

Climate

Azerbaijan is a non-Annex 1 member country of The United Nations Framework Convention on Climate Change (UNFCCC). Therefore, Azerbaijan does not have quantitative commitments to reduce greenhouse gas emissions. As a developing country, Azerbaijan participated in the Kyoto Protocol Clean Development Mechanism, which stimulated the development of climate-related institutions and projects. With the help of the Norwegian government, a project on capacity building has been implemented. Azerbaijan is participating in the reporting about its climate measures in the 'National Information to the UN Framework Convention on Climate Change'. Despite the lack of a climate change strategy, a number of laws have passed to mitigate climate impacts, as well as government programmes.

4.4.6 Germany-Czech Republic-Slovakia: Engage people in landscape restoration

The realization of complex measures for water retention in the landscape, local climate improvement and sustainable landscape management, is through projects which are financially supported by the EU and the Czech national government. The approach comprises the water-soil-climate nexus and the land-food-energy nexus. Through project meetings and seminars, where stakeholders meet experts with whom they can discuss the project issues, the purpose of the measures are explained, and commitment is built. The intention is to involve stakeholders in landscape restoration and make them enthusiastic and familiar with the measures. ENKI, together with regional offices and the national administration, organizes informal seminars for all stakeholders that are interested in landscape restoration measures and have potential to acquire and spread knowledge about the connection between water, vegetation and climate. They also have potential to implement the water-vegetation-climate concept in regional decisions. One project is the 'System of Landscape Adjustments for Adaptation of the Agricultural (agro-forestry) Landscape to Climate Change in the Period 2030+', initiated by the Technological Agency of the Czech Republic and realized by the Czech University of Life Sciences in Prague.

Stakeholders (state officers, scientists, regional authorities) also meet irregularly to discuss the issue of 'drought conception', to prepare for the implementation of measures to mitigate the negative impacts of drought and water scarcity. These drought abatement measures are planned to be realized by the South Bohemia Region regional office and by other small local authorities, e.g. the town Dačice and few private farmers. Another attempt aims to involve the national networks of Local Action Groups and Association of municipalities in implementation of the Governmental 'drought conception'. ENKI and the local action group Třeboňsko stimulated the negotiations between the Regional office of South Bohemia and the Advisory board of the 'drought conception'.

People are motivated through the subsidies and financial support that provide income. Open-minded stakeholders adopt the ideas of landscape restoration that is realized on their own land with financial support from different sources (EU, national budget). There is still a gap between written strategies, action plans and real local measures on the spot mainly in the Czech Republic.

On the Slovak side, thanks to the NGO People and Water Initiative, the Water Rehabilitation Programme for the Košice Region was developed. The aim of the Programme is to implement, within the next 5-10 years, water-saving measures that will retain rainwater with positive impacts on prevention of floods and droughts, carbon sequestration and stabilization of crop production. These measures will be taken in forest, agricultural and urban landscapes. It will also contribute to the production of biomass. Based on this initiative, the Košice regional leadership plans to sign the Green Memorandum that will start a cooperation of all the Slovak regions in this programme with a transboundary perspective for the Czech Republic, Hungary and Poland. The regional government is preparing an action plan for 2019 to create conditions for the implementation of the programme in 2020. This initiative emerged from the experience and success stories from the year 2011, when after the floods, the Government of the Slovak Republic started the ecosystem restoration of the damaged landscape as part of the prevention of floods, drought and regional climate rehabilitation.

4.4.7 France-Germany: New topics stimulate nexus framing; Transboundary cooperation

New topics help to integrate the nexus domains and deal with more complexity: Sustainable Development, Cities, Soils, Food Autonomy, Health, Mobility, Circular economy. These topics are top of the agenda of municipalities.

The difference between the French centralized and German decentralized governance structure is mentioned as a possible limiting factor in cooperation between the two. Also, the policy visions differ, e.g. electricity prices are high in Germany, therefore it is cost-effective to invest in PV installations; in France, electricity is cheap so there is no incentive to invest in renewables. Norms and thresholds for water pollution differ between France and Germany as well as continuity of ecological status of rivers across borders. This is being dealt with through the ICPR (International Commission for the Protection of the Rhine). There is not homogeneity, but at least there is shared understanding and knowledge. For transboundary cooperation, suitable inputs such as funding are key. Interreg (European Regional Rural Development Fund budget for transboundary projects) can be mobilised in the Upper-Rhine region. A limiting factor is that funds are under-spent because 1) stakeholders do not know they are eligible, 2) application processes are too complex. The language barrier remains a problem for some stakeholders and prevents their involvement in transboundary processes. CSR (Conference of Upper-Rhine) provides help, translates documents and assists stakeholders in their contacts with their counterparts.

4.4.8 Andalusia: Success factors in Rural Development Programmes and Climate Change Law.

Public participation, cooperation, transparency and legitimacy are highlighted as the main success factors in the development and implementation of the Rural Development Programme (RDP) 2007-2013 in Andalusia. The different interest groups were involved in the diagnostic SWOT analysis and selection of measures, together with the regional government. This resulted in successful impacts for the water-land-agriculture-climate nexus and the socioeconomic environment.

According to the Ex-post evaluation of the 2007-2013 Andalusia Rural Development Programme, water quality improved through reductions in the use of synthetic products and sustainable soil management, which also contributed to decreased soil erosion and runoff. Concerning climate change, the RDP also had a positive impact through the increase in carbon sequestration and biomass production. In socio-economic terms, the RDP contributed to economic growth and employment in the agricultural sector. Nevertheless, recommendations were to reinforce the Programme monitoring system and to strengthen the coordination between the different Regional Ministries that are involved in the RDP's measures management.

A multi-actor approach, financial support and ownerships are key success factors in the EIP-AGRI (European Innovation Partnership for Agricultural productivity and Sustainability) operational groups, supported by the RDP 2014-2020. These groups bring together farmers, companies, NGOs, researchers and government authorities to develop an innovative project that promotes resource efficiency and low carbon economy.

Cross-sectoral cooperation, public participation and transparency are the main success factors in the design of the recently approved 'Law 8/2018 of measures against climate change and for the transition to a new energy model in Andalusia'. The crosscutting nature of the law is addressed with the participation in the process of an inter-ministerial committee that includes different regional ministries (Agriculture; Environment; Employment, Enterprise and Trade). Furthermore, the Economic and Social Council (a participatory body which includes regional economic and social organisations) is involved in the endorsement of the law. In addition to this, the public is invited to participate with proposals and observations throughout the process.

4.4.9 Sardinia: Trust built by accepted knowledge

Integrated assessment and sharing the results of scientific analyses created a base for cooperation in Sardinia. Stakeholders found the results realistic and this built trust. Discussion over the results allowed a clear basis on which to share problems and possible solutions. Prior knowledge of the possible interactions among sectors was critical to build WLEFC nexus-oriented policies. The implementation of the policy needed to be flexible. Integrated Water Management has improved through investments in infrastructure and skills but also thanks to communication with multiple interested stakeholders and increase in data transparency.

Policies oriented towards the production of technologically advanced solar farms perhaps represent the best WLEFC nexus success story as these are being built in the perspectives of reducing the energy costs for water pumping and thus the price of water. Such planned infrastructure originated from the cooperation between the energy and water sector and to a lesser degree the agricultural sector. This is noteworthy as there is a general lack of formal mechanisms to promote synergies among sectors as well as a diffuse silo thinking. The Success factors in this example were knowledge sharing, cooperation, multi-actor approach and ownership.

Past regional governments increased the production of renewable energy, however these were in part considered uncontrolled and caused misuse of agricultural and forest land. The negative public perception led to a stricter control and to policies regulating land-use. The success factors for these new regulations were social awareness and rule of law.

At present, Sardinia is presenting its Regional Adaptation Plan which is, at least in part, considering potential synergies among sectors, especially climate, water and agriculture. Notably, the Climate-Water-Agriculture interactions are derived from the Sardinian Nexus model. The success factors in this were communication of results, multi-actor approach and the reliability of results.

4.4.10 South-West England: Success and failure in nexus policy making and implementation

Trust and transparency between stakeholders were critical aspects of a successful policy that spanned nexus sectors. A policy needs long term support and stability to achieve buy in from multiple actors across sectors. The need to be flexible in policy design and implementation was also apparent. A valuable lesson seems to be in the ability to respond quickly to any unforeseen consequences in enacting a policy, recognising that not all outcomes can be predicted and acknowledging that altering policies is not the sign of a failed strategy, rather the outcome of an open-minded and innovative policy department.

There is a lack of coherence in policy making across many nexus sectors in the UK and few formal mechanisms exist to address policy coherence. Informal networks therefore seem to play a significant role in cross-sectoral cooperation. It would certainly be useful if policy makers were more aware of these informal networks and could utilise them in terms of nexus thinking and policy making. However, the nature of these networks is that they are often long established and built on trust and reciprocity. It may be difficult to gain access to these networks and care needs to be taken to ensure that using the networks does not alter their existence in a negative way. However, when done thoughtfully and in an open and receptive manner, the outcome is likely to be valuable.

Catchment Sensitive Farming

Catchment Sensitive Farming (CSF) is a policy that has been working in specific Priority Catchments where agriculture is having the most significant impact on rivers, lakes and estuaries in the South-West River Basin. It's a programme that works with farmers to improve the quality of water in rivers, lakes and beaches. It has been successfully running for twelve years. One of the reasons that the project is such a success is the partnership at its heart. It has built confidence amongst farmers and the long-term support has led to the programme becoming embedded in the community and well-respected among farmers.

Renewable Heat Incentive (RHI)

The legislation for the Renewable Heat Incentive was delivered in the 2008 Energy Act in order to deliver renewable heat to assist the UK in meeting its EU renewable energy targets. The RHI is based around providing financial incentives to encourage consumers away from traditional forms of heating. Long delays, budget limitations and policy mistakes have resulted in low levels of take-up for the scheme and where there has been take-up there have been issues around non-compliance and manipulation of the scheme's rules resulting in overpayment. The RHI has therefore failed to meet its objectives and has not offered value for money for the £23 billion expected total cost to tax payers (House of Commons, 2018). The Department for Business, Energy and Industrial Strategy (BEIS) were over-optimistic regarding the take-up for the RHI. There was little insight into consumer decision making around heat and no clear comprehensive, inclusive and flexible heat strategy. This has meant that the government has had limited control over the resultant pathway and has been ill-equipped to deal with the issues that have arisen. In this instance, the department for BEIS should have had far greater input and expertise around the policy design and roll out in order to prevent such shortcomings.

In light of the mistakes made in the roll out of the renewable heat incentive, lessons should be learned. To avoid the land and agriculture implications that arose from the implementation of the RHI, stricter rules should have been implemented around biomass and biogas to ensure true carbon savings and to avoid inappropriate land conversion. Alongside this, policy makers need to be swifter in responding to issues that emerged with the policy deployment. An awareness around the limitations of modelling to predict the run of events in the wake of future policy implementation would help ensure policy makers were braced for early interventions when necessary.

Hinkley Point C

In 2006, 'The Energy Challenge' set out a scenario in which new nuclear power stations were one answer to ensuring that Britain met its carbon reduction targets without disruption to the network. In 2007 it was declared that the consultation process leading up to the release of the policy document supporting nuclear had been seriously flawed. However, in 2008 it was announced that a new generation of nuclear power stations in the UK would be formally backed by the government. After the banking crisis of 2008, it became clear that the UK electricity consumers would be footing the bill for the nuclear build and the deal that was struck was to be a disaster for energy consumers. More recently, the falling cost of renewable energy only serves to exacerbate the failure to UK consumers in the signing off of Hinkley Point C. Various assessments were carried out in order to work out the viability of the proposal, but the

setting is already home to the Hinkley Point Nuclear Power Station Complex. In June 2017, the National Audit Office confirmed that the Hinkley deal was both overpriced and high risk. A report by the Public Accounts Committee in 2017 highlighted the diminished financial case for Hinkley over time and raised concerns over the government's failure to thoroughly reconsider the original deal to go ahead with the build despite the costs to the consumer rising fivefold in the years following the decision. This highlights the lack of transparency, rigour and accountability that is often associated with energy schemes. Information regarding the impact of such decisions on the wider energy landscape should be made more explicit, particularly when decisions have the potential to become political, and not solely based on economic or environmental reasoning.

Table 8. Success and failure in cross-sectoral policy making and projects in the national cases of SIM4NEXUS.

Success Mixed Failure Neutral

	Greece	Latvia	Sweden	The Netherlands
KNOWLEDGE				
Information	Exchange of knowledge and expertise between Ministry of Environment and Energy, research institute and power company. E.g. collaboration committee between Ministry of Environment and Energy and the Hellenic Public Power Corporation S.A. The committee is working effectively during the policy design process (exchange of knowledge and expertise).	Environmental NGOs in cooperation with Forestry Consulting Service Ltd. are organising free of charge informative seminars for various stakeholders (e.g., land, forest owners) on environmentally friendly forest and land management.	Informal institution: EU project funding in the forestry sector - forestry authorities apply for external funding to increase knowledge base, with focus on linking knowledge from different sectors in water-related questions.	Various arrangements have enhanced the information level during the past 10 years, an example is the 'Transition house for the biobased economy'.
	Design of regional plans and regional policies for climate change adaptation. Ministry of Environment and Energy-School of Chemical Engineering (NTUA). Generation and integration of different types of information: Understanding interconnection between			Stakeholders miss information on long-term investment opportunities.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement NO 689150 SIM4NEXUS

	climate (GHGs) and energy sources.			
	Implementation of investments in agriculture and energy sectors. Involved actors: Bank sector – private individuals. Generation and integration of different types of information: understanding interconnections between agriculture-energy-water and energy-climate, generation of cross-sectoral knowledge based on the understanding of interconnections between nexus sectors.			
	Design of policies for protection of biodiversity and wetlands. Involved actors: WWF Greece-Ministry of Environment and Energy. Understanding interconnection between climate, biodiversity and water.			
Relational learning	In 7 out of 16 arrangements, trust was an enabling factor for the ability to work properly. In 8 out of 16 success stories, trust was a factor.	Integrated Energy and Spatial planning through establishment of Regional Living Lab comprising stakeholders from different sectors to elaborate a common perspective for production and utilisation of renewable energy sources in transport within Zemgale region (experience from Horizon2020 project 'INTENSSSS-PA'.	'Predatory fish' project: good relationship between NGO and regional and local authority and mutual trust, built over time. EU LIFE project linked to forestry and water.	Relational learning is in focus ever since the project 'Botsende Belangen' (Conflicting Interests), where a joint public-private learning process investigated legal limitations and opportunities.

	Design of regional plans and regional policies for climate change adaptation: Knowledge sharing (scientific expertise – policy design), trust between stakeholders (cooperation between a recognized authority and a recognized academic and research institute), common language across different nexus sectors, common definitions.		Informal arrangements for knowledge sharing based on good will, some work, others do not.	There is little cooperation and relational learning between actors dealing with different types of biomass.
	Policies for PVs. Involved actors: Ministry of Environment and Energy-Hellenic Association of Photovoltaic Energy Producers. Knowledge sharing (professional expertise – policy design), trust between stakeholders (discussing trade-offs in case of conflicting interests), interdependency between stakeholders.		All informal arrangements in Swedish case study depend to a large extent on trust.	
	Implementation of investments in agriculture and energy sectors. Knowledge sharing (agricultural practices – energy production practices – investments), trust (complementary goals), interdependency between stakeholders (funding, investments).		If interdependency is lacking, this can be a limiting factor – like implementation of WFD in Sweden. Forestry sector is not dependent on water authorities and water authorities don't have power to 'force' forestry actors to do anything.	
	Design of policies for protection of biodiversity and wetlands.			

	Involved actors: WWF Greece-Ministry of Environment and Energy. Knowledge sharing (experience – policy design), diffusion of expertise and sharing of experiences.			
Uncertainty	Design of regional plans and regional policies for climate change adaptation. Consider multiple possible scenarios for long-term governance planning.	The planning process of the implementation of the EU water policy does not go smoothly due to fragmented background data and scarce availability of estimated effects from measures already implemented. This makes the planning ambiguous and creates resistance towards new measures.		The image of biomass is negative, and this creates uncertainty for the businesses involved and the general public.
Complexity				There are many different types of biomass, they all have their own use options and issues. It is a complex sector. There are conflicting interests between biomass for energy and bio-based and the circular economy.
SOCIAL DYNAMICS				
Cooperation	Implementation of investments in agriculture and energy sectors. Involved actors: Bank sector – private individuals.		Success in the policy arrangement 'Regional development and cooperation in the environmental objectives system (RUS)', due to cross-sectoral cooperation; has led to an increased awareness of environmental issues.	'Grasgoed' (using grass as raw material for different uses). Collaboration of land owners, nature organizations, businesses, knowledge institutes in the EU Interreg/EFTO project of the Dutch province Noord-Brabant

				and the Belgian province Antwerp.
	Design of policies for protection of biodiversity and wetlands. Involved actors: WWF Greece-Ministry of Environment and Energy. Cross-sectoral cooperation, intensive collaboration, mutual comprehension, discussion.		Cross-sectoral cooperation is lacking in the implementation of the WFD.	Cluster 'Bio energie Oost-Nederland': collaboration of enthusiastic broad scale of parties from a range of sectors: knowledge sector, industry, energy, working on innovation.
	Cooperation of Greenpeace Greece with 1) farmers and 2) fishermen. 1) Promoting cultivation of traditional fodders with less pesticides. 2) Protection of marine population and sustainable development of fishery.			
	Cooperation between Greenpeace Greece and Ministry of Environment and Energy to establish energy communities to promote energy saving in small communities.			
Leadership			The formal institutional arrangement RUS has as its main goal to share knowledge across county boards, works due to some driven individuals.	The Dutch government has taken a leadership role during the past 10 years, mounting to policy plans for biomass for the mid-term (2030). Involving private business and NGOs has created co-leadership.
			Linked to relational learning, particularly building trust and common language.	

			Leadership is important in all informal arrangements and also some formal (e.g. working group steering the work of RUS)	
Fair and equal power			Seems to be important in almost every arrangement, particularly in the case of creating common vision/goals.	Stakeholder workshop: priority given to energy and climate, which means circular economy and resource efficiency are not in the picture.
Ownership and commitment	Broad acceptance of RES by decision makers and society, e.g. household PVS, funding of PVS, establishment of wind parks.		'Predatory fish' project is driven by committed individuals (leadership is also important in this case).	The Dutch government has triggered private leadership by stimulating business and NGOs to take charge (co-ownership of problems and solutions) in the 'Top sector' policy (for strong sectors in the economy) and in the Climate tables'
	Acceptance by the farmers of reduction of dangerous pesticides use and development of organic farming.		Social willingness is frequently mentioned, e.g. land owner's willingness to cooperate, committed individuals etc..	
Visioning	Common goals and interests in collaborations, leading to compromises in conflicts about policy content and responsibility. E.g. collaboration committee between the Ministry of Environment and Energy and the School of Chemical Engineering (NTUA), between Ministry of Environment and Energy and the Directorate of International Energy issues (Ministry of Foreign Affairs),	Institutions/organisations present and share opinions, actively seeking participation in collaborative arrangements, related to common goals to be achieved, e.g. sustainable development, rational use of resources.	In two of the formal arrangements described, the authorities are said to have long experience in combining different objectives in their decision making. In two policy arrangements 'common interest and goals' are highlighted as factors of success. It is also mentioned in the general conclusion as one of the factors contributing to achievements made in Sweden. Long term goals and visions are	The policy document 'Biomass 2030' contains a vision for biomass for energy as well as for the bio-based economy. In addition, energy is being invested in the development of a joined vision: examples are the Transition agenda and the Climate tables.

	collaboration committee between the Ministry of Environment and Energy and the Hellenic Public Power Corporation S.A. the following is stated: “sometimes conflicts arise concerning the content of policy documents and the role (responsibilities) of HPPC as a national energy provider but usually a compromise decision is taken as there are common interests and common goals."		important for successful implementation.	
	Conflicting interests, perspectives and profits.	Both nature conservation experts and forest/land owners acknowledge the need for dialogue to find balance between nature protection and economic activities.	The success of implementing EU climate goals is contributed to the political will and priority given to climate change, as well as clear long-term vision/strategy of Sweden as fossil free nation.	
	Design of regional plans and regional policies for climate change adaptation. Common understanding of problems, needs, solutions, goals, etc..	National Bio-economy Strategy 2030.	Lack of political will is issue for the implementation of some policies: production and development objectives are prioritized, while objectives linked to environmental aspects and particularly biodiversity conservation have been given lower political priority, thus leading to limited implementation.	
	Design of policies for protection of biodiversity and wetlands. Involved actors: WWF Greece-Ministry of Environment and Energy. Compromises and			

	dedication to common goals for the future.			
LEGITIMACY				The joint collaborative character of the policy making-process has enhanced the legitimacy. The 'Climate tables' are a way of gaining legitimacy.
Existing framework				The 'Climate tables ', i.e. discussion and working groups with stakeholders that define climate policy, were built on a former climate agreement between the national government and stakeholder groups.
Authority			Sweden has created five key water authorities based on main catchments, which coordinate water management issues, with some success.	The government asked private partners to initiate projects during the build-up of the transition agenda, but then put these on hold because of the rise of the climate tables. This is undermining its legitimate authority in the eyes of many stakeholders and reducing enthusiasm.
			The authorities created for the implementation of WFD lack the authority to implement any real changes in other sectors e.g. forestry, lack of recognised interdependency adds to the problem.	
Government support	Promotion and funding of organic crops.		Support from government, legislation, higher authority is important in all formal	Climate policy currently has priority above bio based and circular economy, so all political attention and policy making

			arrangements and can also be helpful in informal arrangements.	effort concentrated on climate sidelines the circular economy.
Public awareness			Environmental education in early stage to create society that is aware of and can deal with environmental problems.	Biomass has a negative image, created by the discussion about its sustainability, impact on GHG emissions, land, biodiversity, water
Transparency			Very important for trust building	Different visions about sustainability of biomass, its bad image and complexity are clouding the picture.
Accountability				Stakeholders demand long-term stability in regulation and finances, to secure their investments.
Rule of law			Appropriation directions from the government (public service agreements, so-called 'Regleringsbrev') is a strong regulatory instrument that authorities abide by, although it is not specifically cross-sectoral.	Stakeholders mentioned laws and rules as a hindering factor to try out innovations and pilots.
				Sustainability criteria for biomass are disputed and unclear, registration systems EU are unclear.
RESOURCES				
Financial and human resources	Investments in agriculture and energy sectors. Cooperation between the Bank sector and private individuals.	The planning process of the implementation of the EU water policy does not go smoothly due to lack of man power and capacities.	Important in all formal arrangements.	The Dutch government has invested in the process and public-private financing in Biomass policy, Bio-based economy, Top sector policy, Climate tables).

			Financial support from the European Union is a success factor in two policy arrangements.	'Grasgoed': EU Interreg/EFRO co-financing brought actors together in the provinces of Noord-Brabant (NL) and Antwerp (Belgium), this collaboration was a success.
			The formal institutional arrangement RUS: lack of finances is hampering full development of their work.	SDE+ subsidy (stimulating sustainable energy production) stimulates the use of biomass for energy generation and puts biomass for Bio-based & Circular Economy at a disadvantage
Guidelines, responsibility, roles and tasks			Annual directions from the government provided to all authorities, outlining key activities, targets, budget and how the budget will be allocated to different activities. Specifies what goals should be achieved and the reporting required.	In climate and energy policy, parties have agreed upon objectives, the challenge is implementation in practice, stakeholders argue. Problems are the lack of clarity with respect to the usage of biomass and the many rules and regulations.
			The stakeholder workshops highlighted that the instruments being used change over time, due to circumstances such as 'political climate'.	
Capability of actors	Design of regional plans and regional policies for climate change adaptation. Actors have the capability to boost the change and to change own behaviour.			
MONITORING				
	Regional plans and regional policies for climate change	Fragmented background data and scarce availability of estimated effects from		Intention to integrate SDGs monitor with 'Monitor Brede Welvaart' (Prosperity Monitor).

	adaptation, progress is monitored.	measures already implemented. Budget cuts in monitoring programmes during economic crisis.		
	Policies for PVs, progress is monitored	University of Latvia is developing a system model for environmental indicators at national, regional and local level. Assuming cross-sectoral aspects will be covered.		Monitoring systems for climate and SDGs are in place.
	Implementation investments in agriculture and energy sectors. Progress is monitored.			
	Progress of protection of biodiversity and wetlands is monitored.			
OUTPUT				
Horizontal coherence				Conflicting policies between the 'Cascade' principle and biomass for energy generation.
Vertical coherence			As national level climate policies in Sweden are set very high, the EU levels for e.g. % of renewable energy have already been achieved, so EU policies do not give support to proceed with implementation of national policies.	For most global and EU policies, national implementation is on track: the SDGs, Paris, Renewable Energy directive, CAP.
				Bird/Habitat directive: management plans are well prepared but not yet in force.
IMPACT				

Goals met cost-effectively				
Sustainable				SDG monitor: Development within NL largely sustainable, but import creates spill over.
				Critical note in national SDGs monitor and OECD SDGs monitor on sustainability of Dutch agriculture.

Table 9. Success and failure in cross-sectoral policy making and projects in the transboundary and regional cases of SIM4NEXUS.

Success Mixed Failure Neutral

	Germany-Czech Republic-Slovakia	**France-Germany**	**Andalusia**	**Sardinia**	**SW England**
KNOWLEDGE					
Information		The state wine culture institute's research creates a bridge between the agriculture and the climate sectors on a long timescale – adapted to the challenge of climate change. Also experiments,	The National Irrigation Plan–Horizon 2008 and the Andalusian Irrigation Agenda Horizon 2015 did not consider interconnection between water and energy. These plans achieved water	One of the key success factors is well-structured and transparent environmental impact assessment (EIA) that includes an analysis of coherence with policies. The EIA has often halted	The Renewable Heat Incentive (RHI) has led to unintended consequences for land, agriculture and water. The use of agricultural crops in heating AD (anaerobic digestion) plants has created

		proofs of concept and education.	savings but led to an increase in energy consumption in irrigated agriculture.	unsustainable plans or improved them as in the case of thermal solar plants.	competition with food production, reduced soil and water quality and has not delivered carbon abatement cost effectively.
		The Ecophyto plan failed due to the neglect of the dependency of the system on pesticides.	Changes in the energy policy over the last years (Royal Decree Law 1/2012, Law 24/2013 Electric Sector and Royal Decree 900/2015) have hampered the development of renewable energy and increased the cost of energy. These changes have led to negative effects on irrigation in agriculture and climate.	Entrepreneurs in the forest, agriculture and renewable energy sectors are interested in new solutions and often highly skilled in environmental issues but complain about weak communication and shared information with institutions.	
		More and better impact assessments (integrating more nexus domains and taking into account larger scales).			
Relational learning	G. Most informal arrangements only take place when trust and common (economic) interest are present.	Upper Rhine Conference: transboundary governance organisation, successful due to informal and formal institutional arrangements; from informal learning, establishing trust to proposing legal texts. Trust is built in an informal setting.		During workshops all stakeholders highlighted the need for shared and trusted information across sectors.	Farming communities tend to rely on informal networks with neighbouring farms and these are often more trusted than more formal networks, which farmers often don't have time to attend to.

Uncertainty		Especially relevant for long-lasting infrastructures: dams and reservoirs, energy production plants, forests, vineyards, city planning, … Once it is here, you cannot remove it or change it.		Models are not able to provide reliable projections.	
Complexity	Cz.: Climate models are not able to adequately describe the relations between land cover - atmosphere - temperature - evapotranspiration - rainfall. Therefore, these relations are not considered in climate mitigation strategies.	Includes complexity related to low kinetics, e.g.: pollution of groundwater due to farming practices decades ago, sediments pollution due to industrial sites now closed, … what can we do about this legacy?			
		New topics help to integrate the nexus domains and deal with more complexity: Sustainable development, Cities, Soils, Food Autonomy, Health, Mobility, Circular economy, … these topics are top of the agenda of municipalities.			
SOCIAL DYNAMICS					
Cooperation	Sk: There is no clear link between	The difference between the French centralized and	The formulation of the Law 8/2018 of measures		Catchment sensitive farming (CSF) and upstream

	landscape management and individual sectors (water, energy, agriculture, food safety and the climate). Implementation of EU legislation does not consider mutual effects.	German decentralized governance structure is mentioned as a possible limiting factor in cooperation between the two.	against climate change and for the transition to a new energy model in Andalusia is done by an inter-ministerial committee that includes different regional ministries (Agriculture; Environment; Employment, Enterprise and Trade). The public and interest groups such as environmental NGOs, and professional organisations are also involved in the process of drafting the climate change law. This cooperation enables the definition of a crosscutting policy to face climate change.		thinking, and the healthy homes for wellbeing project are working on a cross-sectoral basis, across more types of organisations (including public, business, NGOs and farmers) and across more sectors (water, land and agriculture / food)
		Initiatives to promote energy savings in households are led by ADEME (Energy Agency in France) whereas initiatives to promote water savings are led by the water agencies … No coordination / cooperation means less efficient solutions are implemented.	In the implementation of the Andalusian Rural Development Programme 2014-2020, and drafting of climate change laws, different regional ministries worked together (Agriculture; Environment; Economy; Employment, Enterprise and Trade) with groups of interest (professional organisations, environmental NGOs) and		

			experts in the design of the programme measures.		
		Many opportunities for cooperation in the Upper-Rhine region, especially among universities / research centres, or among municipalities. There are funding mechanisms and cooperation arenas (forums, conferences, platforms, associations, …).	Agreement of Mayors for Climate & Energy. Initiative integrated in the Andalusian Urban Sustainability Strategy to meet the objectives of reducing emissions. The covenant is applied in 1700 municipalities in Spain and more than 7000 municipalities in Europe have signed it. It promotes cooperation between different institutions to reduce emissions.		
		Services in the region or state do not communicate enough. The infrastructure department is planning works that are against the biodiversity or the water policies supervised by another department… Instead of finding synergies, it leads to compensations…	EIP-AGRI operational groups supported by the RDP 2014-2020. These groups bring together farmers, companies, NGOs, researchers, administration to develop an innovative project that promotes resource efficiency and low carbon economy focus, based on the needs of farmers and companies.		
		Overlapping informal arrangements (GECT, CRS, ICPR, EUREGIO, …).			
Leadership	Cz.: one visionary strong person has initiated and been	Idee Alsace successfully created an association for the implementation of		Failures are attributed to weak management and	

	responsible for the restoration of agricultural landscapes and hydrology, increased biodiversity and reduced erosion and local climate change.	industrial ecology at local level, for example with the Port of Strasbourg.		sectorial bound perspectives.	
Fair and equal power		French biodiversity law 2016: some articles were never implemented or bypassed, apparently due to low priority by the authorities that had to implement them. The sequence ERC (Avoid – Reduce – Compensate) should prevent damage to the environment. In truth, no project was cancelled because of potential damage to biodiversity. The project leaders always find ways to compensate (giving money to local associations).		NGOs and other civil organizations have a growing power and were able to halt the uncontrolled use of agricultural land for solar and wind energy farms.	
		Stakeholders addressed the power of political parties, private businesses and civil society organizations. Their relative weight in decision-making fluctuates over time and depending on the issue. Influence of			

		lobbies / pressure groups is hard to assess.			
Inclusion		Language barrier remains a problem for some stakeholders to be involved in transboundary processes. CSR (Conference of Upper-Rhine) provides help, translates documents and assists stakeholders in their contacts with their counterparts.	Ex-ante evaluation of the European Regional Development fund (ERDF) programme 2014-2020. Application of the partnership principle throughout the planning stage. Likewise, the consultation procedure involved all interested agents.		
		"Call for projects" are quite well established on environmental issues or infrastructures. This is beneficial for the authority issuing the call as this highlights its policies / priorities. This is beneficial for the project manager as he/she remains in charge, gets funding as well as gains visibility.			
Ownership	Cz.: Personal identification with realized measures.	The stakeholders believed that if one was to utilize mostly information-related instruments in implementing important policies it was very important to introduce environmental aspects early on in education systems to create a society that is aware of and can			

		deal with environmental problems.			
	Cz.: Informal arrangements work because of the enthusiasm of the involved people. Sk: The arrangements work regionally because of the awareness of the Košice region government.	Diffused responsibility may cause not achieving objectives. This is especially relevant for strategies that aim to integrate various policy domains. "No one feels responsible for the implementation of general strategy documents" is what a public officer stated after being asked about the importance of an integrated strategy.			
Visioning	Cz.: The issue of water retention needs the interest and willingness for large changes from the top political structures, as it is in Slovakia.	SRADDET (Regional Territorial Strategy) combines all nexus domains. So far, it is only strategic planning (unsure if implementation will follow, no constraints and no penalties if orientations are not respected), but this is already a significant improvement.	Draft of the Andalusian Bio-economy Strategy promoted by the Regional Ministry of Agriculture and designed by an Inter-ministerial Committee that includes different regional ministries in Andalusia (Agriculture; Environment; Employment, Enterprise and Trade). The development of this strategy allows for cooperation between different sectors (agriculture, energy).	Strong silos thinking and lack of a formal nexus-oriented coordination.	Hinkley point C- nuclear power generation (decarbonisation objective): failure because the power plant is likely to make local renewable energy generation – which is regionally important –less viable in the South West, through crowding out at regional level.
		The RBMPs (River Basin Management Plans) are attempts to integrate		Failures are attributed to weak management, sectorial bound	There was recognition of 'siloed' thinking in policy making and failure to

		several domains but they remain centred on water issues and are hardly embodied into the other sectoral policies.		perspectives and short term thinking of development.	recognize cross-sectoral issues. One stakeholder said that they were not aware of 'any inter-sectoral relationships among public organisations', and another said there was a need for more people to see 'common sticking points'
		Different norms / thresholds for water pollution between France and Germany or for ecological continuity of rivers. Being dealt with through the ICPR. Not a perfect homogeneity but at least there is shared understanding / knowledge.			The Renewable Heat Incentive (RHI) is thought to have failed because of lack of consensus across different types of organisations and conflict with other policy priorities.
		ICPR: "Stakeholders need to realise that compromises are necessary in an interconnected world, and not a failure".			
LEGITIMACY					
Existing framework	SK.: the initiatives by the Košice region follow the government programme for landscape restoration that have been running since 2011.	Today's policies have a fixed duration (from 5 years water policies, up to 70 years for the state concession of large infrastructure), which makes it easier for stakeholders to identify			CSF has been a long running project and it is this continuity and apparent stability that has led to success.

		when to get mobilised. But policy agendas are not tuned (water policies not being revised at the same time as the agriculture policy).			
Authority		Who is in charge of the nexus? No one … there are think tanks, conferences, research projects but no real authority. When funding stops, or people change job, the network collapses.			
Government support	Cz., Sk.: Support mainly from regional authorities.	Examples to be taken from Fessenheim (old nuclear power facility to be shut down, many jobs threatened, needs strong political vision to create a new economy on the territory: being discussed right now with orientation on PV).			Catchment Sensitive Farming is supported by Defra, the Environment Agency and Natural England.
Public awareness	Cz., Sk.: Raising of public awareness and education are needed, a newer way of thinking than traditionally in villages.		Although the mechanisms to involve public in policy-making, such as 'Transparency portal' in the website of the regional government or different committees for social participation (e.g. Andalusian Environmental Council, Andalusian Water Council), participation is	Increasing but still low public awareness emerges from interviews.	

			still limited because of the lack of public awareness.		
	G.: Increased public awareness can be partly credited for success of resource efficiency.				
Transparency		How to show the real price of productions / uses (impacts on biodiversity, water quality, CO_2 emissions, etc)?			
		Criteria for decision-making in stakeholder processes should be clearly defined. Stakeholders confirmed this during the workshop.			
Accountability					
Fair rule of law	G.: The various laws and regulations for resource efficiency are mostly responsible for the success.	Legislation is often a constraint to innovation, for instance on waste, water reuse, carbon tax.			The Renewable Heat Incentive (RHI): much blame is given to the lack of clear guidelines, regulations and enforcement of the policy. Policy interpretation was noted as an issue, including how conflicts are likely to arise due to inconsistencies in how regulations are interpreted and enforced by regulators at the regional level.
	G.: Policies are much more likely to be successful, if all parties				

	have a benefit from adherence to the regulations and objectives.				
RESOURCES					
Financial and human resources	Sk.: The government used unemployed people to realize landscape water retention measures.	Especially for transboundary cooperation, suitable inputs such as funding are key. Interreg fund (ERDF budget for transboundary projects) can be mobilised in the Upper-Rhine region. Problem is that funds are under-spent because 1) stakeholders do not know they are eligible, 2) application processes are too complex.		Well skilled entrepreneurs waiting for occasions to pick-up the challenge. Often, effort is voluntary.	Catchment sensitive farming is government funded.
Flexible, progressive guidelines		The growing demand of organic food in the region, and the inability of the system due to agricultural subsidies to switch, has made the region a net importer of organic food			The Renewable Heat Incentive (RHI): much blame is given to the lack of clear guidelines on the introduction of the policy.
					Use of evidence to demonstrate the impacts of CSF, which also enables to target priority areas and adapt the programme to local circumstances in order to have the biggest impact.
Capability					

MONITORING					
				During workshops all stakeholders highlighted the need for shared and trusted information across sectors.	
OUTPUT					
Horizontal coherence		Environmental legislation and urban planning create double impacts on agriculture: through loss of land (infrastructure and compensation measures).	ERDP 2014-2020: Programme presents high internal coherence, there are synergies among the objectives.	There is a general coherence in the regional policies, but stakeholders warn that inconsistencies and synergies may be more evident at a lower level of analysis (technical issues as legislative gaps).	
Vertical coherence		What is the right scale for the nexus? If too small, the authority can encompass all nexus domains but has little means to implement ambitious changes. If too big, the authority must split its policies into domains and there are communication / cooperation issues between services and conflicting priorities.	ERDP 2014-2020: external coherence of the programme that is in line with the European, national and regional policies.	Regional policies are coherent with national and European goals.	Renewable Heat Incentive (RHI): policy interpretation was noted as an issue, including how conflicts are likely to arise due to inconsistencies in how regulations are interpreted and enforced by regulators at the regional level.
IMPACT					
Goals met			The Ex-post evaluation of the 2007-2013 Andalusia Rural Development programme (RDP) shows	Increase in renewable energy production and improved water management with	

			successes in the impact, related to the nexus of water-soil-agriculture-climate.	consequent reduction in prices for irrigation water and better management of drought events.	
			Although the River Management Plans have enhanced the state of water bodies in Andalusia, there are still specific problems of overexploitation and water quality.		
Cost-effective		Depends on the country / point of view: electricity prices are high in Germany; therefore, it is cost-effective to invest in PV installations. In France, electricity is cheap so there is no incentive to invest in renewables.			
Sustainable			RDP 2007-2013 contributed to people (employment), planet (water, soil, climate) and profit (economic growth).		Catchment sensitive farming should result in less cost further down the line.

Horizon 2020 Societal challenge 5
Climate action, environment, resource
Efficiency and raw materials

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement NO 689150 SIM4NEXUS

5. Success factors at global scale: lessons learned from the SDGs

This chapter presents an analysis of the process, output and impact of the Sustainable Development Goals by referring to the framework of success criteria as developed in this report. The Sustainable Development Goals (SDGs) are the codification of the 2030 Agenda for Sustainable Development. They are universal, and while not legally binding they provide a normative framework for how states can develop sustainably in the period 2015-30. As this chapter will show, the SDGs can be considered as the ultimate policy nexus. They can be viewed as a policy success story and best practice through their synergistic aims and participatory conception which led to an integrated framework which addresses each of the elements of the water-land-energy-climate-food (WLEFC) Nexus. It is too early to give a definitive analysis on the impacts of the SDGs as in late 2018, we are only three years into a 15-year cycle. Early indications suggest that while there are issues with financing and capacity for monitoring and reporting, positive steps are already being taken.

5.1 Introduction

The 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs) which codify it are the policy output of a thorough, three-year policy making process which considered nexus relations and each of the elements of the water-land-energy-climate-food (WLEFC) Nexus. In this chapter, the historical background and context of the evolution of the SDGs is outlined, before the policy output, impact and policy formation process are discussed and compared to the success factors described in the Framework for successful nexus governance in Chapter 2.

5.2 Historical context

The SDGs are the result of an evolution in global development thinking which has moved from a focus on mainly economic gains to an integrated understanding of the relationship between the people, planet and profit. Over the last half-century, it has been argued that the economy is a product of society which exists in a finite environment (Boulding, 1968) and the incumbent form of development is unsustainable (Ehrlich 1968, Meadows et al., 1972; UN, 1993). Nonetheless in the intervening decades most development paths have been characterised by reliance on resource intensive industrialisation to maximise economic growth. This has led to unequal results for people within and between societies and disastrous impacts on the environment as the concept of planetary boundaries has gained in traction[1]. To address these concerns, the concept of sustainable development emerged. The World Commission on Environment and Development defined sustainable development as that which "meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987; article 27), and established that sustainable development is built on three fundamental and interlinked pillars; society, environment and the economy. However, despite changing perceptions of the importance of the biosphere for development, the environment did not play a significant role in global development frameworks until recently. The Millennium Development Goals

[1] Ten planetary boundaries have been suggested, including several directly related to the water-land-energy-food-climate (WLEFC) Nexus including carbon emissions, land converted to cropland and consumption of water. Further it has been stated that interactions of each of the boundaries can impact on the safe operating levels of other boundaries. In the absence of significant socio-economic changes, in the next decades keeping to these boundaries will be increasingly difficult as we attempt to supply more food, water and energy to an increasing population with increasing demands (SRC, 2018).

(MDGs) which ran from 2000-2015 made significant strides in tackling poverty but were critiqued for neglecting the environment and taking a siloed approach to development whereby the interlinkages between policy spheres were not addressed (box 1).
The Sustainable Development Goals (SDGs) which will run from 2015-2030 provide the first global framework for states to develop in a manner which balances the social, environmental and economic needs. There are specific goals to address most developmental challenge and an overarching goal on how to achieve them in an integrated manner (Figure 2). The agreement explicitly mentions that the Agenda is based upon previous United Nations conferences related to sustainable development and highlights that the challenges which these processes reveal demonstrate the need for a new integrated approach:

Sustainable development recognizes that eradicating poverty in all its forms and dimensions, combating inequality within and among countries, preserving the planet, creating sustained, inclusive and sustainable economic growth and fostering social inclusion are linked to each other and are interdependent.

(UN 2015a; article 13).

Figure 2. The 17 Sustainable Development Goals

Box 1: The SDGs as a response to the failings of the Millenium Development Goals

The **Millenium Development Goals** (MDGs) which ran from 2000-2015 were somewhat successful in addressing global poverty but were critiqued for disappointing gains for land-locked and small island developing states (SIDS). They also failed to consider how attaining one goal could negatively impact on the attainment of other goals (Weitz et al., 2014). Moreover, the MDGs lacked an environmental focus. While one of the goals was explicitly focused on the environment, the targets which comprised the goal were rather vague and more related with basic needs than the environment:
MDG 7 – ensure environmental sustainability
Target 7a: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources.
Target 7b: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss.
Target 7c: Halve the proportion of the universal population without sustainable access to clean and safe drinking water and basic sanitation by 2015.
Target 7d: Achieve substantial improvement in the lives of a minimum of 100 million slum dwellers by 2020.

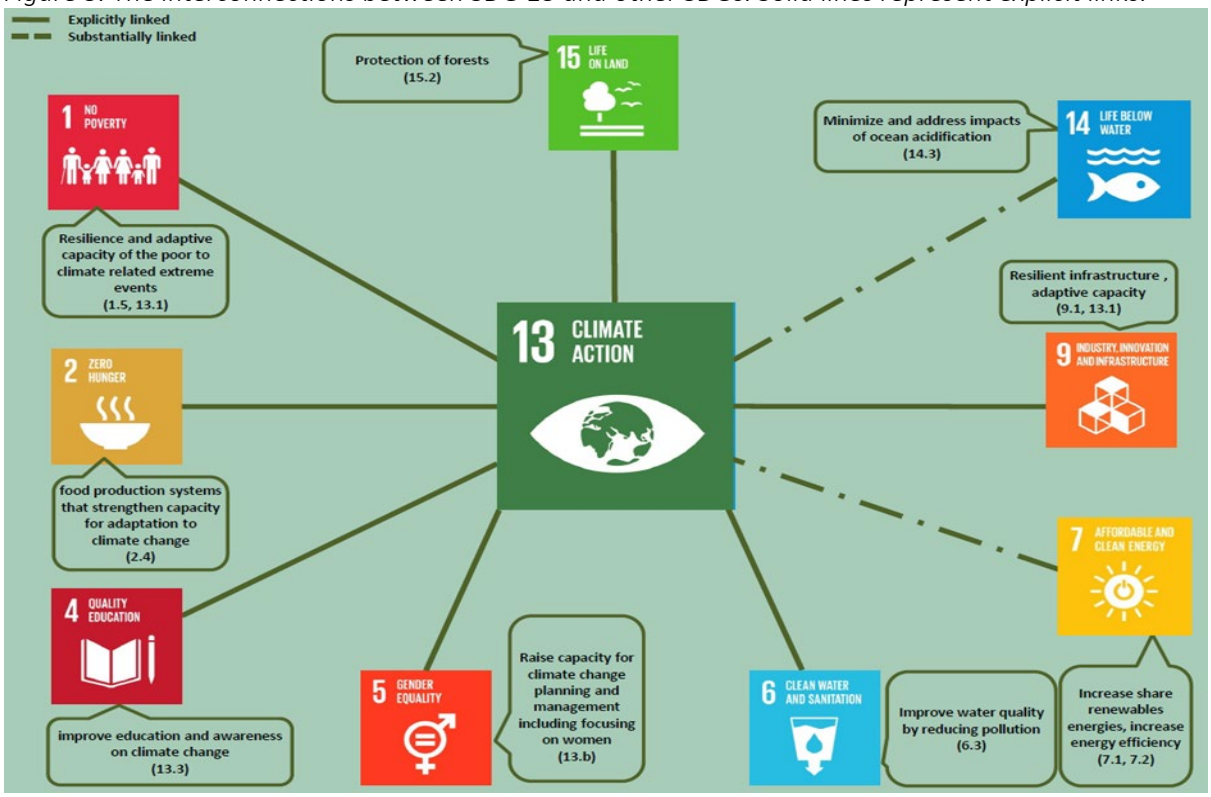
Target 7a was vague as the principles of sustainable development were not explicitly stated, while reversing the loss of environmental resources also lacked specificity. Targets 7c and d, while vital for development could not be understood as primarily focused on the environment. In addition to the poor specificity of MDG7, the environment was barely addressed by the other MDGs, belying both a lack of integration and a lack of focus on the environmental pillar of sustainable development relative to the economic and social pillars. The siloed nature of the goals inevitably led to trade-offs in policy production and implementation. These lessons learned were key to the conception of the SDGs which placed sustainability at the core of development as the planet was given an equal footing with people and profit. The vision of the SDGs was based on the experiences of the Millennium Development Goals, and the legitimacy which the process and relative success of the MDGs bestowed.

5.3 Policy Output

5.3.1 Cross-sectoral horizontal policy coherence

The 2030 Agenda for Sustainable Development uses a broad framing of development; in addition to people, planet and prosperity the agreement recognises that sustainable development can only occur with peace and in partnership with all countries and peoples. In all there are 17 goals, divided into 169 targets, the attainment of which are to be measured by 232 indicators. The importance of cross-sectoral policy coherence is shown by the fact that there is a separate goal to that end (Nilsson et al., 2016). However, the targets and indicators for that goal are rather vague and the exact interactions of different SDGs have not been officially documented. Therefore, it can be said that although the SDGs were conceived of as an integrated framework, details are still lacking (Weitz, 2018). Nonetheless, it is not difficult to conceptualise their connections (Figure 3). Although there are many natural synergies between specific SDGs, there are also numerous natural trade-offs. Looking at four of the SDGs, (2,3,7 and 14) it was found that there are 316 target interactions, 238 (75%) of which are positive, 66 (21%) are negative and 12 (4%) are neutral (Griggs et al., 2017). The sheer scale of interactions is shown by looking at just one of the SDGs. In a study of SDG7, it was found that looking at Agenda 2030 there are potentially 143 synergies and 65 trade-offs relevant to the achievement of targets (Nerini et al., 2018).

Figure 3. The interconnections between SDG 13 and other SDGs. Solid lines represent explicit links.



Source: UNEP (2016)

The occurrence in the WLEFC Nexus in the SDGs is shown by table 10, which indicates where the different branches of the WLEFC Nexus are addressed explicitly or implicitly by the SDGs. This shows that exploiting synergies in the WLEFC Nexus is necessary for the attainment of the SDGs. Consideration of the WLEFC Nexus alone will not be sufficient as a recent article highlighted that there are as many as 20 different nexuses of direct relevance to the attainment SDGs (Liu et al., 2018). Further horizontal integration connects several other UN development frameworks which were developed over the same period. The Sendai Framework for Disaster Risk Reduction, The Paris Climate Change Agreement, the Agenda for Humanity, the New Urban Agenda were all developed in the post 2015 era while the SDGs are also in step with existing frameworks such as the Convention on Biodiversity and Convention to Combat Desertification providing opportunities for horizontal policy coherence.

Table 10. The presence of the WLEFC Nexus in the SDGs (Source: Author).

SDG	**Explicit** or implicit relationship of targets and indicators with Nexus				
1. No poverty	**Food**	**Water**	**Energy**	**Climate**	**Land**
2. Zero hunger	**Food**	**Water**		**Climate**	**Land**
3. Good health and well-being	Food	**Water**	**Energy**	Climate	**Land**
4. Quality education		**Water**	**Energy**		
5. Gender equality	**Food**	**Water**	**Energy**	Climate	**Land**
6. Clean water and sanitation		**Water**		Climate	**Land**
7. Affordable and clean energy	Food	Water	**Energy**	**Climate**	Land
8. Decent work and economic growth	Food	Water	**Energy**	**Climate**	Land
9. Industry, innovation and infrastructure	Food	Water	**Energy**	**Climate**	Land
10. Reduced inequalities	Food	Water	Energy	Climate	Land
11. Sustainable cities and communities	Food	**Water**	**Energy**	**Climate**	**Land**
12. Responsible consumption and production	**Food**	**Water**	**Energy**	**Climate**	**Land**
13. Climate action	**Food**	Water	**Energy**	**Climate**	Land
14. Life below water	**Food**	**Water**	Energy	**Climate**	**Land**
15. Life on land	Food	**Water**	Energy	Climate	**Land**
16. Peace, Justice and Strong Institutions					
17. Partnerships for the Goals			**Energy**		

5.3.2 Trade-offs managed or mitigated, transparent choices made in case of conflicting instruments, objectives or goals

While the goals and their targets are designed to be mutually reinforcing, with numerous synergies, it is important to realise that potential trade-offs can and will occur and ignoring them could have significant negative impacts (Timko et al., 2018). However, while synergies and the interconnectedness of the SDGs are mentioned in the Agenda, there is little explicit recognition of trade-offs. The Agenda takes an overly optimistic and unrealistic approach by not directly acknowledging the inevitability of competing goals as trade-offs have already been identified (Griggs et al., 2017; Nerinin et al., 2018). In practice this means the responsibility falls on policy makers, normally at state level, who are responsible for each goal to consider how the achievement of their targets and goals could interact with other targets and goals and communicate with other ministries and stakeholders to map out how to address interactions with targeted policies to address trade-offs (Nilsson et al., 2016).

There is also a need to integrate policy vertically and SDGs need to be connected to national development agendas. For example, when considering SDG5 Climate Action, it is necessary to consider National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs) within the climate policy sphere. This suggests the need for accurate and up-to-date knowledge on how other SDGs and related policies can affect sectors outside of the policy makers' immediate field. Identified in article 60 as key to this is the "…Global Partnership which will facilitate an intensive global engagement in support of implementation of all the Goals and targets". There is even a target for policy coherence; "17.14 Enhance policy coherence for sustainable development" and an indicator has been developed to keep track whether states have produced a policy on coherence. This is not sufficient to fully understand how goals and targets interact, and one way to track such interactions would be to extend the data analysis

and reporting of the 9 pilot countries (Nilsson et al., 2016). Nonetheless, it should be noted that interactions are very much context specific and can vary through time and space (Nilsson et al., 2016).

5.4 Policy Impact

5.4.1 Objectives and goals met in all sectors

The UN produces the Sustainable Development Goals Report every year to review progress in attaining the goals. The latest report states that while gains have been made, at current trajectories the goals will not be met by 2030 and calls for urgent accelerated action (UN, 2018). Particularly alarming are the latest figures on funding. Only 5 states contributed 0.7% of Gross National Income to Overseas Development Aid (ODA) in 2017; Denmark, Luxembourg, Norway, Sweden and the UK. This meant that a global figure of only 0.31% of GNI was given over to ODA in 2017 (UN, 2018). Relatedly, funding for statistics in developing countries is very low, with only 0.3% of ODA set aside for statistics. This lessens the ability of states to implement and monitor development agendas and so the implementation of the SDGs (UN, 2018).

The effectiveness of the SDGs will also come down to their implementation. As there is room within the goals for context specific and adaptive policy making, it is possible for states to experiment and develop best practices. A necessary precondition for this will depend on new forms of communication between ministries to design and implement policy synergistically. For this reason, the monitoring of the SDGs is essential. The importance of follow-up and review at the global, regional and national level to ensure accountability, track progress, promote best practice is included in the Agenda. There is an official tracking website (https://sdg-tracker.org/). Out of 193 countries, as of late 2018, 162 voluntary national reviews have been submitted. Such monitoring is already vital in adapting and fine-tuning policies to give a better chance of attaining the goals by 2030. It is also clear that the final success of the SDGs will require that by 2030 the SDGs will have formed a basis for future, sustainable growth from 2030.

Recent research has highlighted the depth of the challenge in realising the 17 SDGs for the 9 billion people who will be on the planet by 2030, whilst not crossing the earth's planetary boundaries (SRC, 2018). It has been projected that if current trajectories continue, only 10 of the 17 goals will be achieved by 2030 and this will only be achieved by exceeding the safe zones for 8 of the 9 planetary boundaries (SRC, 2018). The report highlights five transformational steps which would need to be taken to reach most SDGs and minimise the number of planetary boundaries which are exceeded; increased use of renewable energy, increased food sustainability, new modes of development, inequality reduction and social development to include education, gender equality, health and family planning (SRC, 2018). As a result, it may be that transformative governance is necessary for the achievement of the SDGs (Stevens and Kanie, 2016). There will be additional complications if findings of the special report on the impacts of global warming above 1.5 °C report are included (IPCC, 2018). It is therefore essential that states are able to use the flexibility within the Agenda to respond to new risks and knowledge which emerge over the timeframe of the framework.

Box 2: The inevitability of trade-offs and the necessity for synergies

The inevitability of trade-offs in any policy environment can be demonstrated from the research of Von Neumann and Morgenstern (1951) in their seminal work *Theory of Games and Economic Behavior*. They proved that it is impossible to maximise two variables by considering as the basis for their proof the utilitarian ideal of "the greatest good for the greatest number". They showed that it is theoretically possible to design policy which satisfies some people 100%, or everyone but only somewhat. This does not mean that synergies are impossible, rather perfect synergy is impossible, and striving to attain it could lead to the trap of the double maximand.

The impossibility of maximising two variables equally applies in this sphere. Therefore the SDGs and sustainable development in general have temporal, sectoral and spatial limits. Firstly, as the Bruntland Commission definition of sustainable development states, there is a need to balance present and future needs (WCED, 1987), for example unfettered economic growth now may limit future economic growth. Secondly, a policy which has a positive income in one region or country, could have a negative impact in another region (Liu et al., 2018), if polluting industrial methods move from one country to another. Thirdly, it is possible to achieve a particular goal or target but contribute to negative impacts in other goals and targets. For example, meeting climate targets through using hydropower could directly impact on SDGs related to food (SDG2) and water (SDG6) and indirectly on peace (16) (Wetlands International, 2017)

In practice this means that prioritisations must be made. Even under optimisation, in the policy or computing world there must always be a hierarchy (Batanović et al., 2011). This is not to say that sustainable development is impossible, but rather to state that it is only possible to develop sustainably if a) development is redefined to make less demands of the earth and b) a nexus approach is adopted whereby policy makers work to minimise trade-offs and maximise synergies. Even when these two conditions are met, truly synergistic policy will only be created and implemented if all sectors have equal power.

5.5 Problem definition, goals setting and policy-making

5.5.1 Knowledge Management

From the start of the policy making process, there was a shared vision of the need and direction of the SDGs. Central to everything was the recognition of the three pillars of sustainability; the economy, environment and society and that they are interrelated. Furthermore, the economy and society were understood as part of, and therefore dependent on the health of the environment (Figure 4). This later expanded to include the five P's; people, planet, prosperity, peace and partnership. It was also decided that the vast range and types of information and needs should be integrated into a limited number of aspirational and easy to communicate goals. Furthermore, Agenda 2030 and the SDGs demonstrate a broad understanding of feedback loops between the goals, the differences between national, regional and global scales and the challenges which aligning these levels present.

Figure 4. Economy and society as subsets of the environment. Source: Folke et al. (2016)

5.5.2 Social Dynamics

At the United Nations Conference on Sustainable Development (Rio +20) it was decided that while the MDGs had been successful in reducing poverty, there was a need for a different approach for the next development framework which would focus on sustainability. From the beginning, it was decided that the SDGs would be developed through an inclusive process. Article 248 of the agreement which came out Rio+20 established the way in which the eventual goals would be developed, clearly signalling the participatory nature of the policy design process:

We resolve to establish an inclusive and transparent intergovernmental process on sustainable development goals that is open to all stakeholders, with a view to developing global sustainable development goals to be agreed by the General Assembly.

UN (2012; paragraph 248)

As a result, the SDGs were the outcome of an unprecedented breadth and depth of consultation. This is in stark contrast to the MDGs, which were criticised for being imposed from above and "came as a surprise and it took five years to understand them and five years to work them into national development plans, leaving only five years to actually implement them" (UNDP Philippines, 2015).
The ownership of the SDGs by relevant actors is a result of the discussions which began at the United Nations Conference on Sustainable Development in 2012 and lasted until 2015. It was a long and detailed participatory, transparent approach which gained the perspectives of the largest possible number of stakeholders. Not only did this process help to develop and refine the goals, the communication it entailed also contributed to building trust between actors. The Open Working Group was set up in early 2013 and under the United Nations Development Program, the process involved

states, intergovernmental organisations and non-governmental organisations. A task team was comprised of 60 UN agencies, a high-level panel of 27 experts and regional, national and global thematic consultations. Web based platforms were also used to maximise the number of people who could contribute to the process (Stevens and Kanie, 2016). A global survey known as MY World was designed to capture the widest possible range of perspectives of people around the world. Approximately 8.5 million people were involved in the conversation around the globe (UNDP Philippines, 2015) although it has been argued that such methods will always exclude some people and communities unable to access and use technology to contribute (Gellers, 2016). **The process to agree on the targets was similarly consultative. An online process enabled civil society, academia and the private sector to have input on the draft indicators which had been drawn up by states and the UN** under the Inter-agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs).

While many people were consulted in what could be termed a bottom-up process, it has been argued that the SDGs themselves are better understood as top-down as overarching issues were selected, with goals and targets then chosen to best solve the identified issues. This meant that addressing interactions is difficult as must be done despite the framework design as opposed to through it. The result is a list of disparate and potentially conflicting targets (Weitz et al., 2014). As such a better process would have been through selecting targets first as this would better stimulate discussion around interrelationships and create more efficient policy (Weitz et al., 2014).

5.5.3 Resources

One potential and serious limitation to the achievement of the SDGs is a lack of financial support. The 2030 Agenda states that OECD countries should commit to spending 0.7% of GDP on official development assistance and 0.15-2% on least developed countries. However, the non-binding nature of the Agenda means that these numbers are more aspirational than actual; few states commit such funds and the funding gap for developing countries alone has been estimated at 2.5 trillion per year (UNCTAD, 2014). Nor is there provision for ensuring that the finance is used in a balanced manner; each state has primary responsibility for its development and so can decide how best to use its internal and external funds. The Addis Adaba Action Agenda sets out how domestic and international business can be harnessed to contribute to funding the attainment of the goals (UN, 2015b). The preferred sources for funds are domestic as such sources can be more sustainable. For this reason, there is a need for national financing frameworks. Furthermore, while the private sector has been earmarked as an important source, until now investments have been somewhat limited.

5.5.4Monitoring, evaluation and reporting

Once the SDGs were agreed, a further consultative process resulted in the creation of specific representative and measurable indicators to test the attainment of the targets. The Global Indicator Framework was established by the Statistical Commission in March 2016. Just as it is the state's responsibility to decide how they will design policy to achieve the SDGs, national governments also have responsibility for follow-up and review of the success of their implementation. Targets are aspirational and global, with governments setting their own priorities according to national circumstances and how to integrate targets into national policies. Follow-up and review occur at the national, regional and global levels and is voluntary and country-led. The annual SDG Progress Reports and annual Global Sustainable Development Reports provide snapshots of attainment at global, regional and national levels. In practice, the efficacy of the monitoring and evaluation depends on the capacity of the state and capacity building for monitoring is addressed explicitly by target 17.18 which mentions the need to improve data collection.

5.5 Conclusion

This chapter has shown that the SDGs could certainly be considered an example of best practice of nexus policy in terms of the ambitious way in which they were conceptualised. A range of actors provided time and expertise to produce new integrated knowledge through a participatory process in

which stakeholders took ownership. This meant that for the first time a global development framework was produced which placed people and planet on the same level as profit. The resulting output of 17 goals are presented as interrelated suggesting both horizontal and vertical coherence and synergies are possible. Crucially, the way in which states can operationalise win-win forms of development are not identified; therefore, the exploitation of synergies is not facilitated. Nor does the framework explicitly address the issue of trade-offs, so their avoidance is not effectively managed. Therefore, it is for states and other actors to tailor the SDGs to their priorities and needs and design and implement the most effective policy.

Until now objectives and goals have not been met in all sectors. One reason for this is a lack of resources. The lack of finance will be a significant obstacle. While generally effective indicators have been developed, it will be necessary to continue to develop capacity for monitoring in developing countries. Perhaps the biggest obstacle to successful implementation will be the need to stay within planetary boundaries. Societal and economic transformation may be necessary to make less demands on the planet. Perhaps more practically, there is an urgent need to better define the interactions of the SDGs and the role of WLFEC Nexus and other links between policy areas and cross-sectoral, cross-scale and cross-regional integration still need work (Liu et al., 2018). This would make the SDGs more cost-effective and efficient, reduce trade-offs and boost sustainable resource use (Weitz, 2018). For this reason, the SDGs can be termed ‘a globally significant test for the implementation of nexus thinking’ (Ringler et al., 2013; 617).

6. Conclusions

This report presents a Framework for successful nexus governance in a nexus driven resource efficient Europe. Success factors were identified based on a detailed literature review, tested on eight multi-sectoral cases assessed as successful and completed by SIM4NEXUS case studies. The developed framework was applied to assess nexus policy success in regional, national and transboundary SIM4NEXUS case studies.

Successful policy making from a water-land-energy-food-climate (WLEFC) nexus viewpoint addresses policy coherence, explores synergies and finds solutions for conflicts and trade-offs between the nexus components at biophysical, socio-economic and governance level. These criteria make high demands on the policy-making and implementation process. Being successful in a nexus approach has many dimensions and is multi scale. It involves the whole policy cycle, from problem definition and nexus framing, to defining goals and objectives, policy options and instruments, resources, implementation, monitoring and evaluation. As competences are differently divided between administrative levels for the nexus components, and trade-offs in the nexus cross scales as well as sectors, the governance of the WLEFC nexus is multi-sectoral and multi-scale.

Success factors identified in literature and by the cases are divided in the categories Knowledge management and relational learning, Dealing with uncertainty and complexity, Social dynamics, Resources and Monitoring, evaluation and reporting. Success factors do not stand alone and are interrelated. Implementation of the success factors should be tailor-made to the issues at stake and the actors involved. As the list of success factors is extensive, the question could be asked when nexus governance is good enough. This can only be explored by applying nexus approaches for policy-making in practice. None of the analysed cases in this study applied all success factors and none of the examples brought forward by the SIM4NEXUS cases involved all five sectors of the WLEFC nexus. Apparently, this is beyond the scope, competence and scale of current governance institutions. Typically, one of the nexus sectors is point of departure in the examples supplied by the cases, and relations with other sectors are investigated and considered from that central viewpoint. Cases indicated that organisations were not always aware of interdependencies, synergies and trade-offs related to other sectors. In practice, nexus policy-making and implementation are narrowed down to what is feasible and what is surveyable. All the sectors of the WLEFC nexus are considered in the Sustainable Development Goals, although their interactions are yet to be formally mapped.

Successful nexus policy-making depends on political will, mindset, knowledge management and careful organisation of the process. Political will must be available to broaden the scope beyond the usual sectoral perspective, focus on common goals instead of the own sectoral goals, give up power for shared interests, invest in a complex and probably lengthy policy-making process and contribute resources to reach common goals. It takes a mindset that wants to understand other perceptions of problems and solutions than your own, other cultures, interests and visions. And it takes the courage to face uncertainty and complexity that forces an experimental pathway and flexibility, adjusting to new findings and changing circumstances. To be able to do this, an effective monitoring system must be in place. Knowledge about the interconnections between the components in the nexus, and knowledge sharing between sectors and scales, are key for a nexus approach, not only scientific knowledge, but also knowledge from practice brought forward by stakeholders.

The added value of a nexus approach - more benefits from synergies, conflicts and trade-offs foreseen and addressed, and innovative solutions created by cross-sectoral relational learning - should be demonstrated to persuade politicians and policy-makers. All policy-making implies decisions about conflicting interests, otherwise policies would not be necessary, so what makes a nexus approach different from the usual procedures? In principle, a nexus approach does not differ from the usual

practice in the European Union policy-making, where comprehensive impact assessments, scenario analyses, inter-service steering groups between DGs, public consultations, and information sharing about the policy-making process are well institutionalized. European policy for WLEFC sectors already reckons with potential conflicts and trade-offs to other sectors. For example, water policies involve land use, energy generation, agriculture and climate, and energy and climate policies are closely connected. Agricultural policy includes cross-compliance with environmental and climate policy. However, there is no institutionalised procedure for a comprehensive nexus assessment of new policies and options for synergy are not systematically investigated. The results of such assessments could define the scope of the policy-making and guide the decision to apply a nexus approach or not, and if the answer is yes, what nexus, what sectors and what aspects of the sectors will be included in the process.

New integrating themes can stimulate a nexus approach. Such themes are for example circular and low-carbon economy, sustainable supply and consumption of healthy food, resource efficiency and planetary boundaries, sustainable cities. These themes cross EU DGs, national ministries and scales, and can be considered as integrating nodes of nexus approaches. New 'nexus approach' institutions, temperate or permanent, can be developed around these nodes to facilitate the policy process.

7. References

1. Adelle, C., Pallemaerts, M. and Chiavari, J., 2009. *Climate change and energy security in Europe policy integration and its limits*. [online] Stockholm: Sieps. Available at: <http://www.sieps.se/publikationer/rapporter/climate-change-and-energy-security-in-europe-policy-integration-and-its-limits-20094.html> [Accessed 8 Jul. 2018].
2. Allen, C.R. and Gunderson, L.H., 2011. Pathology and failure in the design and implementation of adaptive management. *Journal of Environmental Management*, [online] 92(5), pp.1379–1384. Available at: <http://www.sciencedirect.com/science/article/pii/S0301479710003956> [Accessed 11 Apr. 2018].
3. Ansell, C. and Gash, A., 2008. Collaborative Governance in Theory and Practice. *Journal of Public Administration Research and Theory*, [online] 18(4), pp.543–571. Available at: <http://academic.oup.com/jpart/article/18/4/543/1090370> [Accessed 19 Apr. 2018].
4. Apollonio, M., Belkin, V.V., Borkowski, J., Borodin, O.I., Borowik, T., Cagnacci, F., Danilkin, A.A., Danilov, P.I., Faybich, A., Ferretti, F., Gaillard, J.M., Hayward, M., Heshtaut, P., Heurich, M., Hurynovich, A., Kashtalyan, A., Kerley, G.I.H., Kjellander, P., Kowalczyk, R., Kozorez, A., Matveytchuk, S., Milner, J.M., Mysterud, A., Ozoliņš, J., Panchenko, D.V., Peters, W., Podgórski, T., Pokorny, B., Rolandsen, C.M., Ruusila, V., Schmidt, K., Sipko, T.P., Veeroja, R., Velihurau, P. and Yanuta, G., 2017. Challenges and science-based implications for modern management and conservation of European ungulate populations. *Mammal Research*, [online] 62(3), pp.209–217. Available at: <http://link.springer.com/article/10.1007/s13364-017-0321-5> [Accessed 6 Jul. 2018].
5. Bachmann, R., 2001. Trust, power and control in trans-organizational relations. *Organzation Studies*, [online] 22(2), pp.337–365. Available at: <http://journals.sagepub.com.vu-nl.idm.oclc.org/doi/pdf/10.1177/0170840601222007> [Accessed 12 Jul. 2018].
6. Bachmann, R. and Inkpen, A.C., 2011. Understanding Institutional- based Trust Building Processes in Inter-organizational Relationships. *Organzation Studies*, [online] 32(2), pp.281–301. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1005.9820&rep=rep1&type=pdf> [Accessed 12 Jul. 2018].
7. Batanović, V., Guberinić, S. and Petrović, R., 2011. System theoretic approach to sustainable development problem. *Yugoslav Journal of Operations Research*, *21*(1), pp.1-10.
8. Benson, A.J. and Stephenson, R.L., 2018. Options for integrating ecological, economic, and social objectives in evaluation and management of fisheries. *Fish and Fisheries*, [online] 19(1), pp.40–56. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1111/faf.12235> [Accessed 4 Jul. 2018].
9. Berkes, F., Colding Johan and Folke Carl, 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, [online] 10(5), pp.1251–1262. Available at: <http://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/1051-0761%282000%29010%5B1251%3AROTEKA%5D2.0.CO%3B2> [Accessed 10 Apr. 2018].
10. Bernstein, S., 2004. Legitimacy in Global Environmental Governance Environment. *Journal of International Law and International Relations*, 1, pp.139–166.
11. Bodin, Ö., 2017. Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science*, [online] 357(6352), p.eaan1114. Available at: <http://science.sciencemag.org/content/357/6352/eaan1114> [Accessed 4 Jul. 2018].
12. Boulding, K., 1966. The economics of the coming spaceship Earth. InEnvironmental Quality in a Growing Economy. H. Jarrett, Ed: 3–14.
13. Bouwen, R. and Taillieu, T., 2004. Multi-party collaboration as social learning for interdependence: developing relational knowing for sustainable natural resource management.

Journal of Community & Applied Social Psychology, [online] 14(3), pp.137–153. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1002/casp.777> [Accessed 14 Jul. 2018].
14. Breeman, G., 2006. *Cultivating trust: how do public policies become trusted*. [Doctoral Thesis] Leiden University. Available at: <https://openaccess.leidenuniv.nl/bitstream/handle/1887/4321/02.pdf?sequence=20> [Accessed 16 Jul. 2018].
15. Burt, R.S., 2004. Structural Holes and Good Ideas. *American Journal of Sociology*, [online] 110(2), pp.349–399. Available at: <http://www.journals.uchicago.edu/doi/10.1086/421787> [Accessed 8 Jul. 2018].
16. Busenberg, G.J., 1999. Collaborative and adversarial analysis in environmental policy. *Policy Sciences*, [online] 32(1), pp.1–11. Available at: <http://link.springer.com/article/10.1023/A:1004414605851> [Accessed 6 Jul. 2018].
17. Candel, J.J.L. and Biesbroek, R., 2016. Toward a processual understanding of policy integration. *Policy Sciences*, [online] 49(3), pp.211–231. Available at: <http://link.springer.com/article/10.1007/s11077-016-9248-y> [Accessed 2 Jul. 2018].
18. Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jäger, J. and Mitchell, R.B., 2003. Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences*, [online] 100(14), pp.8086–8091. Available at: <http://www.pnas.org/content/100/14/8086> [Accessed 13 Jul. 2018].
19. Christopoulos, S., Horvath, B. and Kull, M., 2012. Advancing the governance of cross-sectoral policies for sustainable development: a metagovernance perspective. *Public Administration and Development*, [online] 32(3), pp.305–323. Available at: <https://onlinelibrary-wiley-com.vu-nl.idm.oclc.org/doi/abs/10.1002/pad.1629> [Accessed 20 Mar. 2018].
20. Commission on Global Governance, 1995. *Our Global Neighborhood*. Oxford: Oxford University Press.
21. Deakin, S. and Wilkinson, F., 1998. Contract law and the economics of inter-organizational trust. In: *Trust within and between organizations: Conceptual issues and empirical applications*. Oxford, UK: Oxford University Press, pp.100–118.
22. Dewulf, A., Craps, M. and Dercon, G., 2004. How issues get framed and reframed when different communities meet: a multi-level analysis of a collaborative soil conservation initiative in the Ecuadorian Andes. *Journal of Community & Applied Social Psychology*, [online] 14(3), pp.177–192. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1002/casp.772> [Accessed 16 Jul. 2018].
23. Dressel, S., Ericsson, G. and Sandström, C., 2018. Mapping social-ecological systems to understand the challenges underlying wildlife management. *Environmental Science & Policy*, [online] 84, pp.105–112. Available at: <http://www.sciencedirect.com/science/article/pii/S1462901117309656> [Accessed 2 Jul. 2018].
24. Edelenbos, J. and Klijn, E.-H., 2007. Trust in Complex Decision-Making Networks: A Theoretical and Empirical Exploration. *Administration & Society*, [online] 39(1), pp.25–50. Available at: <http://journals.sagepub.com/doi/10.1177/0095399706294460> [Accessed 8 Jul. 2018].
25. Edelenbos, J. and van Meerkerk, I., 2015. Connective capacity in water governance practices: The meaning of trust and boundary spanning for integrated performance. *Current Opinion in Environmental Sustainability*, [online] 12, pp.25–29. Available at: <http://www.sciencedirect.com/science/article/pii/S1877343514000529> [Accessed 18 May 2018].
26. Ehrlich, P., 1968. The Population Bomb. New York. NY: Ballantine.
27. European Commission, 2001. *European Governance: A White Paper*. [COM(2001)] Brussels. Available at: <http://europa.eu/rapid/press-release_DOC-01-10_en.htm> [Accessed 23 Mar. 2018].

28. Folke, C., Hahn, T., Olsson, P. and Norberg, J., 2005. Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources*, [online] 30(1), pp.441–473. Available at: <https://doi.org/10.1146/annurev.energy.30.050504.144511> [Accessed 9 Apr. 2018].
29. Folke, C., Biggs, R., Norström, A.V., Reyers, B. and Rockström, J., 2016. Social-ecological resilience and biosphere-based sustainability science. *Ecology and Society*, *21*(3).
30. Gellers, J.C., 2016. Crowdsourcing global governance: sustainable development goals, civil society, and the pursuit of democratic legitimacy. *International Environmental Agreements: Politics, Law and Economics*, *16*(3), pp.415-432.
31. Gerber, L.R., Wielgus, J. and Sala, E., 2007. A decision framework for the adaptive management of an exploited species with implications for marine reserves. *Conservation Biology: The Journal of the Society for Conservation Biology*, [online] 21(6), pp.1594–1602. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/18173483> [Accessed 16 Apr. 2018].
32. Glicken, J., 2000. Getting stakeholder participation 'right': a discussion of participatory processes and possible pitfalls. *Environmental Science & Policy*, [online] 3(6), pp.305–310. Available at: <http://www.sciencedirect.com/science/article/pii/S1462901100001052> [Accessed 5 Jun. 2018].
33. Gray, B., 1985. Conditions Facilitating Interorganizational Collaboration. *Human Relations*, [online] 38(10), pp.911–936. Available at: <https://doi.org/10.1177/001872678503801001> [Accessed 14 Mar. 2018].
34. Griggs, D., M. Nilsson, A. Stevance and D. McCollum (eds.), 2017. A guide to SDG interactions: from science to implementation. International Council for Science (ICSU), Paris.
35. Grindle, M. S., 2007. Good Enough Governance Revisited. Development Policy Review, 2007, 25 (5): 553-574.
36. Gutiérrez, N.L., Hilborn, R. and Defeo, O., 2011. Leadership, social capital and incentives promote successful fisheries. *Nature*, [online] 470(7334), pp.386–389. Available at: <http://www.nature.com/articles/nature09689> [Accessed 19 Apr. 2018].
37. Hoff, H., 2011. *Understanding the Nexus. Background Paper for the Bonn 2011 Conference: The Water, Energy and Food Security Nexus*. [online] Stockholm: Stockholm Environment Institute. Available at: <http://wef-conference.gwsp.org/fileadmin/documents_news/understanding_the_nexus.pdf> [Accessed 15 Mar. 2018].
38. House of Commons, 2018. Renewable Heat Incentive in Great Britain Fortieth Report of Session 2017–19.
39. Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C. and Yalcin, R., 2009. Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and Defining a Research Agenda. *Ecology and Society*, [online] 14(1). Available at: <https://www.ecologyandsociety.org/vol14/iss1/art26/> [Accessed 10 Apr. 2018].
40. IAEG-SDGs, 2018. Tier Classification for Global SDG Indicators *27 November 2018.*
41. IPCC, 2018. O. Hoegh-Guldberg, D. Jacob, M. Taylor, M. Bindi, S. Brown, I. Camilloni, A. Diedhiou, R. Djalante, K. Ebi, F. Engelbrecht, J. Guiot, Y. Hijioka, S. Mehrotra, A. Payne, S. I. Seneviratne, A. Thomas, R. Warren, G. Zhou, 2018, Impacts of 1.5°C Global Warming on Natural and Human Systems. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.
42. Kemp, R., Parto, S. and Gibson, R.B., 2005. Governance for sustainable development: moving from theory to practice. *International Journal of Sustainable Development & World Ecology*, [online] 8. Available at:

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.506.2286&rep=rep1&type=pdf> [Accessed 11 Jul. 2018].
43. Keping, Y., 2018. Governance and Good Governance: A New Framework for Political Analysis. *Fudan Journal of the Humanities and Social Sciences*, [online] 11(1), pp.1–8. Available at: <https://link.springer.com/article/10.1007/s40647-017-0197-4> [Accessed 13 Mar. 2018].
44. Kinnaman, M.L. and Bleich, M.R., 2004. Collaboration: Aligning resources to create and sustain partnerships. *Journal of Professional Nursing*, [online] 20(5), pp.310–322. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S875572230400078X> [Accessed 13 Jul. 2018].
45. Kioe Sheng, Y., 2009. *What is Good Governance?* [online] United Nations ESCAP, p.3. Available at: <https://www.unescap.org/sites/default/files/good-governance.pdf> [Accessed 10 Jul. 2018].
46. Kirschke, S. and Newig, J., 2017. Addressing Complexity in Environmental Management and Governance. *Sustainability*, [online] 9(6), p.983. Available at: <http://www.mdpi.com/2071-1050/9/6/983> [Accessed 11 Jul. 2018].
47. Klijn, E.-H., Edelenbos, J. and Steijn, B., 2010. Trust in Governance Networks: Its Impacts on Outcomes. *Administration & Society*, [online] 42(2), pp.193–221. Available at: <http://journals.sagepub.com/doi/10.1177/0095399710362716> [Accessed 8 Jul. 2018].
48. Kooiman, J., 1993. *Modern Governance: New Government-Society Interactions*. London: Sage.
49. Lawford, R., Bogardi, J., Marx, S., Jain, S., Wostl, C.P., Knüppe, K., Ringler, C., Lansigan, F. and Meza, F., 2013. Basin perspectives on the Water–Energy–Food Security Nexus. *Current Opinion in Environmental Sustainability*, [online] 5(6), pp.607–616. Available at: <http://www.sciencedirect.com/science/article/pii/S187734351300153X> [Accessed 3 Apr. 2018].
50. Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C.L., Schneider, S.H. and Taylor, W.W., 2007. Complexity of Coupled Human and Natural Systems. *Science*, [online] 317(5844), pp.1513–1516. Available at: <http://science.sciencemag.org/content/317/5844/1513> [Accessed 8 Jul. 2018].
51. Liu, J., Hull, V., Godfray, H.C.J., Tilman, D., Gleick, P., Hoff, H., Pahl-Wostl, C., Xu, Z., Chung, M.G., Sun, J. and Li, S., 2018. Nexus approaches to global sustainable development. *Nature Sustainability*, *1*(9), p.466.
52. Lockwood, M., Davidson, J., Curtis, A., Stratford, E. and Griffith, R., 2010. Governance Principles for Natural Resource Management. *Society & Natural Resources*, [online] 23(10), pp.986–1001. Available at: <http://www.tandfonline.com/doi/abs/10.1080/08941920802178214> [Accessed 12 Apr. 2018].
53. de Loë, R. and Patterson, J., 2017. Rethinking Water Governance: Moving Beyond Water-Centric Perspectives in a Connected and Changing World. *Natural Resources Journal*, [online] 57(1), p.75. Available at: <http://digitalrepository.unm.edu/nrj/vol57/iss1/4> [Accessed 8 May 2018].
54. McFadden, J.E., Hiller, T.L. and Tyre, A.J., 2011. Evaluating the efficacy of adaptive management approaches: Is there a formula for success? *Journal of Environmental Management*, [online] 92(5), pp.1354–1359. Available at: <http://www.sciencedirect.com/science/article/pii/S0301479710003701> [Accessed 11 Apr. 2018].
55. Meadows, D.H., Meadows, D.H., Randers, J. and Behrens III, W.W., 1972. The limits to growth: a report to the club of Rome (1972).
56. Meuleman, L.; Niestroy, I. Common but Differentiated Governance: A Metagovernance Approach to Make the SDGs Work. *Sustainability* 2015, *7*, 12295-12321.
57. Morgenstern, O. and Von Neumann, J., 1953. *Theory of games and economic behavior*. Princeton university press.
58. Moss, T. and Fichter, H., 2003. Lessons in promoting sustainable development in EU Structural Funds programmes. *Sustainable Development*, [online] 11(1), pp.56–65. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1002/sd.204> [Accessed 17 Apr. 2018].

59. Munaretto, S. and Witmer M., 2017. D2.1: Water-Land-Energy-Food-Climate nexus: policies and policy coherence at European and International scale. SIM4NEXUS Deliverable, available at: https://www.sim4nexus.eu/page.php?wert=Deliverables.
60. Munaretto, S., Negazc, K. and Witmer, M., 2018. D2.2: Nexus-relevant policies in the transboundary, national and regional case studies. SIM4NEXUS Deliverable, available at: https://www.sim4nexus.eu/page.php?wert=Deliverables.
61. Nair, S. and Howlett, M., 2016. Meaning and power in the design and development of policy experiments. *Futures*, [online] 76, pp.67–74. Available at: <http://www.sciencedirect.com/science/article/pii/S0016328715000439> [Accessed 2 Jul. 2018].
62. Nerini, F.F., Tomei, J., To, L.S., Bisaga, I., Parikh, P., Black, M., Borrion, A., Spataru, C., Broto, V.C., Anandarajah, G. and Milligan, B., 2018. Mapping synergies and trade-offs between energy and the Sustainable Development Goals. *Nature Energy*, *3*(1), p.10.
63. Newig, J., Pahl-Wostl, C. and Sigel, K., 2005. The role of public participation in managing uncertainty in the implementation of the Water Framework Directive. *European Environment*, [online] 15(6), pp.333–343. Available at: <http://onlinelibrary.wiley.com/doi/full/10.1002/eet.398> [Accessed 6 Apr. 2018].
64. Niestroy, I. and Meuleman, L., 2016. Teaching Silos to Dance: A Condition to Implement the SDGs. http://sdg.iisd.org/commentary/guest-articles/teaching-silos-to-dance-a-condition-to-implement-the-sdgs/.
65. Nilsson, M., Griggs, D. and Visbeck, M., 2016. Map the interactions between sustainable development goals: Mans Nilsson, Dave Griggs and Martin Visbeck present a simple way of rating relationships between the targets to highlight priorities for integrated policy. *Nature*, *534*(7607), pp.320-323.
66. OECD, 2017. Complexity and policy making. In: P. Love and J. Stockdale-Otárola, eds., *Debate the Issues: Complexity and Policy making*. [online] OECD, pp.13–33. Available at: <https://www.oecd-ilibrary.org/economics/debate-the-issues-complexity-and-policy-making/complexity-and-policy-making_9789264271531-3-en> [Accessed 2 Jul. 2018].
67. Olsson, P. and Folke, C., 2001. Local Ecological Knowledge and Institutional Dynamics for Ecosystem Management: A Study of Lake Racken Watershed, Sweden. *Ecosystems*, [online] 4(2), pp.85–104. Available at: <http://link.springer.com/article/10.1007/s100210000061> [Accessed 9 Apr. 2018].
68. Pahl-Wostl, C., 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, [online] 19(3), pp.354–365. Available at: <http://www.sciencedirect.com/science/article/pii/S0959378009000429> [Accessed 14 Mar. 2018].
69. Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D. and Taillieu, T., 2007. Social Learning and Water Resources Management. *Ecology and Society*, [online] 12(2). Available at: <http://www.ecologyandsociety.org/vol12/iss2/art5/> [Accessed 16 Jul. 2018].
70. Papadopoulos, Y., 2003. Cooperative forms of governance: Problems of democratic accountability in complex environments. *European Journal of Political Research*, [online] 42(4), pp.473–501. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1111/1475-6765.00093> [Accessed 4 Apr. 2018].
71. Renn, O. and Schweizer, P.-J., 2009. Inclusive risk governance: concepts and application to environmental policy making. *Environmental Policy and Governance*, [online] 19(3), pp.174–185. Available at: <http://onlinelibrary.wiley.com/doi/full/10.1002/eet.507> [Accessed 12 Apr. 2018].
72. Rijke, J., Brown, R., Zevenbergen, C., Ashley, R., Farrelly, M., Morison, P. and van Herk, S., 2012. Fit-for-purpose governance: A framework to make adaptive governance operational. *Environmental Science & Policy*, [online] 22, pp.73–84. Available at:

<http://www.sciencedirect.com/science/article/pii/S1462901112000901> [Accessed 20 Apr. 2018].
73. Ringler C, Bhaduri A, Lawford R., 2013. The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency? Curr Opin Environ Sustain 2013, 5:617-624.
74. Roth, D., Vink, M., Warner, J. and Winnubst, M., 2017. Watered-down politics? Inclusive water governance in the Netherlands. *Ocean & Coastal Management*, [online] 150, pp.51–61. Available at: <http://www.sciencedirect.com/science/article/pii/S0964569117301849> [Accessed 2 Jul. 2018].
75. Roux, D.J., Ashton, P.J., Nel, J.L. and MacKAY, H.M., 2008. Improving Cross-Sector Policy Integration and Cooperation in Support of Freshwater Conservation. *Conservation Biology*, [online] 22(6), pp.1382–1387. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1111/j.1523-1739.2008.01080.x> [Accessed 13 Jul. 2018].
76. Smajgl, A., Ward, J. and Pluschke, L., 2016. The water–food–energy Nexus – Realising a new paradigm. *Journal of Hydrology*, [online] 533, pp.533–540. Available at: <http://www.sciencedirect.com/science/article/pii/S0022169415009816> [Accessed 23 Mar. 2018].
77. Smajgl, A., 2018. Participatory Processes and Integrated Modelling Supporting Nexus Implementation. In: Hülsmann, A. and Ardakanian, R., Editors, 2018. Managing Water, Soil and Waste Resources to Acieve Sustainable Development Goals. Springer, ISBN 978-3-319-75162-7, pp. 71-92.
78. Stevens, C. and Kanie, N., 2016. The transformative potential of the sustainable development goals (SDGs).
79. Stockholm Resilience Centre, SRC, 2018. Transformation is feasible: How to achieve the Sustainable Development Goals within Planetary Boundaries. A report to the Club of Rome, for its 50 years anniversary 17 October 2018.
80. Svensson, S., 2018. *Governance of the Water-Land-Energy-Food-Climate Nexus: an investigation for the conditions of success*. Vrije Universiteit.
81. Termeer, C., Breeman, G. and Dewulf, A., 2010. Paper Towards collective ownership in collaborative processes.pdf. In: *Paper for the 17th Annual MOPAN Conference, 28th-30th June 2010*. [online] MOPAN Conference. Keele University, UK. Available at: <http://transumo.cerium.nl/upload/documents/03%20Projecten/Duurzame%20bereikbaarheid%20Greenport%20Aalsmeer/03%20Output/03%20Toegepaste%20vakpublicaties/Paper%20Towards%20collective%20ownership%20in%20collaborative%20processes.pdf> [Accessed 16 Jul. 2018].
82. Timko, J., Le Billon, P., Zerriffi, H., Honey-Rosés, J., de la Roche, I., Gaston, C., Sunderland, T.C. and Kozak, R.A., 2018. A policy nexus approach to forests and the SDGs: tradeoffs and synergies. *Current Opinion in Environmental Sustainability*, *34*, pp.7-12.
83. UNCTAD 2014. World Investment Report. Investing in the SDGs; An Action Plan.
84. UNFCCC. *Adoption of the Paris Agreement*. Report No. FCCC/CP/2015/L.9/Rev.1, http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf (UNFCCC, 2015).
85. UN General Assembly, 2012. The future we want. A/RES.66/288 (11 September). http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E.
86. UN-HABITAT, 2016. 'HABITAT III New Urban Agenda: Draft outcome document for adoption in Quito'.
87. UNISDR, 2015. 'Sendai Framework for Disaster Risk Reduction 2015-2030'. (http://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf).
88. United Nations 1993. Agenda 21: The earth summit strategy to save our planet.
89. United Nations 2015a. Transforming our world: the 2030 Agenda for Sustainable Development.
90. United Nations 2015b. Addis Ababa Action Agenda.
91. United Nations 2018. Sustainable Development Goals Report 2018.

92. UNDP Philippines, 2015 The Formulation Process of the Sustainable Development Goals and UN Support.
93. Van Bommel, S., Röling, N., Aarts, N. and Turnhout, E., 2009. Social learning for solving complex problems: a promising solution or wishful thinking? A case study of multi-actor negotiation for the integrated management and sustainable use of the Drentsche Aa area in the Netherlands. *Environmental Policy and Governance*, [online] 19(6), pp.400–412. Available at: <http://onlinelibrary.wiley.com/doi/abs/10.1002/eet.526> [Accessed 10 Apr. 2018].
94. Venghaus, S. and Hake, J.-F., 2018. Nexus thinking in current EU policies - The interdependencies among food, energy and water resources. Environmental Science and Policy 90 (2018) 183 - 192.
95. Vink, M., Steen, M. van der and Dewulf, A., 2016. Dealing with long-term policy problems: Making sense of the interplay between meaning and power. *Futures: the journal of policy, planning and futures studies*, [online] 76, pp.1–6. Available at: <https://repub.eur.nl/pub/84301/> [Accessed 2 Jul. 2018].
96. Warner, J.F. and van Buuren, A., 2016. Reframing long-term controversies in transboundary river management. The intermediate role of puzzling and powering in tackling wicked problems. *Futures*, [online] 76, pp.18–29. Available at: <http://www.sciencedirect.com/science/article/pii/S0016328715001652> [Accessed 2 Jul. 2018].
97. WCED, S.W.S., 1987. World Commission on Environment and Development. *Our common future*.
98. Weitz, N., Nilsson, M. and Davis, M., 2014. A nexus approach to the post-2015 agenda: Formulating integrated water, energy, and food SDGs. SAIS Review of International Affairs, 34(2), pp.37-50.
99. Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., Thompson, J., Nilsson, M., Lambin, E., Sendzimir, J., Banerjee, B., Galaz, V. and van der Leeuw, S., 2011. Tipping toward sustainability: emerging pathways of transformation. *Ambio*, 40(7), pp.762–780.
100. Westley, F., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B. and Bodin, Ö., 2013. A Theory of Transformative Agency in Linked Social-Ecological Systems. *Ecology and Society*, [online] 18(3). Available at: <https://www.ecologyandsociety.org/vol18/iss3/art27/> [Accessed 8 Jul. 2018].
101. Wetlands International, 2017. Water Shocks: Wetlands and Human Migration in the Sahel. Wetlands International, The Netherlands. https://www.wetlands.org/download/12385/
102. Wichelns, D., 2017. The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective? *Environmental Science & Policy*, [online] 69, pp.113–123. Available at: <http://www.sciencedirect.com/science/article/pii/S1462901116302970> [Accessed 5 Mar. 2018].