Overcoming Scale Challenges in Policies Through Analysing Governance Architecture: The Case of Chemical Management Policies in Sweden

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Abstract: The release of harmful chemicals into the Earth system is a threat to the survival of human societies and ecosystems. There are different types of harmful chemicals, some possess characteristics that are more harmful than others. Chemicals causing local effects have a short-term impact on the Earth system, whereas others are persistent in nature. The second becomes a global pollution issue because these substances accumulate, resulting in cascades through the Earth system. The chemical pollution issue is a scale challenge, meaning that the pollution issue occurs within and across levels and scales. Chemical pollution is not treated as a scale challenge in the decision-making process today. In the literature it is stated that chemical pollution is usually studied by focusing on single institutions, which hinders the possibility to investigate the linkages between the institutions affecting the scale dynamics. In this study the scale and cross-scale perspective was used to identify institutions that are affecting the work for a toxin free environment on a national and municipality level in Sweden. Governance Architecture was used as an analytical tool to investigate the key hindering and facilitating governance mechanisms to achieve sustainable chemical management in Sweden from a cross-scale perspective. The analytical tool was based on the Earth System Governance theory and scale dynamics. Sweden was used as a case to apply this tool. Two methods were used to gather empirics: literature analysis and in-depth interviews. The findings reveal an overrepresentation of the hindering factors being a result of a scale or a policy gap issue. These gaps are created by the lack of interdisciplinarity in the decision-making process, and the current legislation and politics which influences the implementation of the strategies on the different institutional levels. To overcome these hinders the current strategies and legislation needs to be in collaboration. This study contributes to empiric development within policy studies on how the chemical pollution issue needs to be conceptually formulated to achieve a toxin free environment within and cross-scales. It also contributes to method development by addressing the gap of including several institutions in cross-scale studies.

Keywords: Sustainable Development, chemical toxins, Sweden, governance, policy analysis, in-depth interviews

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Summary:
When studying conservation of chemical management governance of one institution, for example the international institutional level, has been the common focus in the literature. The analysing of several institutions from a holistic approach is a rather unexplored research area when it comes to chemical management. Today we have pollution control laws within EU and policies for a toxin free environment from a global level to local level, despite this the effective governance of pollution has not been attainable in Sweden. The question is why a toxin free environment have not been achieved in Sweden who have worked with achievement of a toxin free environment since year 1999. This study adds to the discussion how to achieve a toxin free environment in practice by investigating Sweden’s chemical management policies as a case. The approach taken to answer this question is to test an analytical tool which is based on Governance Architecture and scale dynamics. Governance Architecture is the intertwining web of institutions, principles and practices that affects decisions by stakeholders at all levels. It includes interplay, interaction, complexes, and constellations. My motivation for focusing on Governance Architecture is that it helps to conceptualise the hindering and facilitating mechanisms in the studied issue by investigating how institutions, principles, norms, regulations, decision-making procedures and organisations are connected. Scale and cross-scale dynamics is a concept used to explain how different scales and levels are connected. Interactions on a cross-level among different regimes occurs when there is a vertical interplay among and between regimes that are situated on different levels on the scale. In the study of cross-scale dynamics both cross-level and cross-scale are included in the analysis. The analytical tool and its components are further explained in the theory chapter. The purpose of this study was to understand how the investigated policies work in practice, and what is missing in the current policies. The focus was on how the current scale dynamics, implementation and policies affect the achievement of a toxin free environment on a national level in Sweden. The aim of this study was that the developed analytical framework used to processing the empirics would contribute to the cross-scale boundary literature and can be of help in policymaking.

Sweden was used as a case to apply this tool and two methods were used to gather empirics. First, a literature analysis was completed including six Swedish policies regarding the national environmental quality goal A Non-Toxic Environment, and Agenda 2030 from a chemical management perspective. Second, in-depth interviews were conducted with key persons working on different levels in Sweden with the achievement of the two goal frameworks; A Non-Toxic Environment, and Agenda 2030. The hindering mechanisms identified were isolations between current EU legislations, such as EU’s chemical legislation REACH and circular economy and trade legislation. Another hinder was isolation between current EU legislations and the strategies on a national and municipality level in Sweden. The hinders were believed to be a result of the current hierarchal, jurisdictional and authority structures. To overcome these hinders the current strategies and legislation needs to reinforce each other. Five facilitating mechanisms were identified as key to create sustainable chemical management; (1) collaboration and cooperation, (2) sharing knowledge and experiences, (3) creating a common vision, (4) applying an integrated approach and (5) build the cross institutional collaboration on interdisciplinarity. These five facilitating mechanisms can be categorized into three types of mechanisms; (1) interdisciplinarity, (2) legislation and (3) politics. The dynamics between these three shows that the chemical pollution issue is foremost an implementation gap due to lack of interdisciplinarity in the decision-making process, and how legislation and politics are influencing the implementation of the strategies on the different institutional levels regarding a toxin free environment. Isolations between policies, short term sustainability and focus on the economic dimension of sustainability was identified as policy gap issues. This study contributes to empiric development within policy studies for how the chemical pollution issue needs to be conceptually formulated to achieve a toxin free environment within and cross-scales. Interdisciplinary understanding and communication about scale interactions can help shed light on deeply rooted governance problems and identify solutions. Considering the broad, ambitious and universal Agenda 2030, collaboration for sustainable policymaking is of greater importance than ever before.

Keywords: Sustainable Development, chemical toxins, Sweden, governance, policy analysis, in-depth interviews

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1. Introduction

The release of harmful chemicals into the Earth system is a threat to the survival of human societies and ecosystems (AMAP, 2004, 2009; Franks, 2011; Lee et al., 2017; Letcher et al., 2010; Murali & Valli, 2017; Rockström et al. 2009a; Steffen et al. 2015; Suk et al., 2016; Tapparo et al., 2012; UNEP, 2012a; Whitmee et al. 2015; WHO & UNEP, 2013). Chemical pollution is a scale challenge because emissions of harmful substances occurs within and across levels and scales. The emissions start as a local pollution issue, depending on the characteristics of the substances the effects might pose only a local problem. In other cases, the substances might be long lived or mobile, these substances will move cross geography and will keep impacting the nature for a longer period, i.e. the substance in persistent (MacLeod et al., 2014; Persson et al., 2013). Substances which are persistent, mobile or bio-accumulative give rise to a global pollution issue when released into the Earth system (Allen, 2013), leaving a large responsibility on the actors affected to solve the issue. These three characteristics are included in Sala and Saouter’s (2014) definition of harmful chemicals and when speaking of harmful chemicals in this thesis their definition is used. To achieve a toxin free environment, the chemical management policies need to acknowledge the occurrence of scale challenges. Today chemical pollution is not treated as a scale challenge in the decision-making process (Armitage, 2008; Beckers, 2006, 2017; Cash et al., 2006; Termeer et al., 2010; Young, 2006; Wilson, 2006). The scholar means that by focusing on single institutions the linkages between the institutions affecting the scale dynamics cannot be studied. Therefore, all the institutions involved in the studied problem are needed to be included in the process.

There is a need for a more and better governance of the Earth system within and across the geographical levels to tackle the challenges of integration for sustainable chemical management (Allen, 2013; Lofstedt, 2014). To study institutions in relation to cross-scale interactions is therefore important (Walker et al., 2009). To be able to answer on which premises a sustainable management of chemicals will be reached in practice we need to understand the role of scale and Governance Architecture in policy integration for sustainable chemical management (Allen, 2013). These questions are of key interest to be able to understand how sustainable chemical management can be reached cross institutions.

In the Earth governance literature, there have been different angles investigated regarding how to govern the Earth system. Some focus on the conditions for knowledge and information transfer at the local level and specifically investigates international institutions and their administrative bodies (Clark et al., 2001). Others focus on the institutional interplay between international environmental regimes (Chambers, 2008; Oberthür & Gehring, 2006; Pittock, 2011). Biermann et al. (2009a) focus on Governance Architecture for better policy integration, which is the focus of this study. The approach by Bierman et al. (ibid.) opens for investigating chemical policies from a multi institutional perspective to gain understanding of how the institutions are unified and separated in the policies. This is the motivation for applying their approach in this study.

There is a research gap regarding the chemical pollution governance issue from a scale and cross-scale perspective including more than one institution. One open question is why the chemical issue is a problem, whether it is a policy gap, scale or implementation problem. To create sustainable chemical management, it is important to understand which variables that are hindering and facilitating interactions between the institutions which are working for a toxin free environment (Glaser & Glaeser, 2014; Ivankova, 2015).

To gain a better understanding whether the research gap regarding the chemical pollution governance issue is caused by policy, scale or implementation, or if it is a combination, this study will apply the Governance Architecture theory. Governance Architecture is one of the analytical problems identified in the Earth System Governance (ESG) framework (Biermann et al., 2007). The framework used in this study combines the ESG framework with the scale framework by Cash et al. (2006). Cash et al. (ibid.) was incorporated to operationalise the scale challenge in the chemical pollution issue. I use chemical policies in Sweden as a case to gather empirics on where some of these cross-scale challenges related to Governance Architecture lie, and to test the developed analytical framework. This study is an attempt to understand mechanisms behind the chemical pollution problem from a governance research perspective. It contributes to Earth System Governance theory by exploring how scale dynamics is seen in governance theory by integrating the frameworks by Biermann et al. (2007) and Cash et al. (2006). The research questions are:

❖ What are the key hindering & facilitating governance mechanisms to achieve sustainable chemical management in Sweden from a cross-scale perspective?
What is the role of scale and Governance Architecture in policy integration for sustainable chemical management?

This study contributes to the empiric development within policy studies regarding how to achieve a toxin free environment within and cross-scales. It also contributes to method development by address the gap to include several institutions in cross-scale studies, which several policy theorists states is an important gap to address (Duit et al, 2010; Stoker, 2018; Young, King & Schroeder, 2008). On the theoretical level the study contributes to the discussion whether the chemical pollution issue is created by scale, implementation or policy gaps. On a practical level it will give a few pieces to the puzzle regarding what is missing in the current chemical management to achieve a toxin free environment.
2. Background and previous research

2.1 Chemical pollution as a cross-scale governance challenge

Chemicals are one of the cornerstones the modern society is based on, it is a part of every home and enterprise in all parts of the world. Chemicals are for example used in cleaning products, in the clothes we wear, in the computers we use, in the water we drink and in the food we eat (Blair et al., 2016; Kumar et al., 2016; Sobek et al., 2016). The global use of man-made chemicals has exploded the last 50 years. By year 2020 UNEP (2012) estimates that the external cost of the emissions will have increased from USD 0.171 trillion to USD 4.12 trillion. The increased use of harmful chemicals that are man-made adds up to enormous quantities on a global level. The emissions are local when released into the environment but as emissions of persistent, mobile or bio-accumulative chemicals increase in number and amount, the pollution becomes an issue on the global level (Allen, 2013; MacLeod et al., 2014; Rockström et al., 2009a, 2009b; Persson et al., 2013). Chemicals know no boarders, meaning that the outflow of harmful chemicals starts at a local level but it travels by air and water (Saia & Goralczyk, 2013; Pozo et al., 2009; Selin, 2010; Weber et al., 2018). The mobility of chemicals across the biosphere makes the chemical pollution a cross-scale problem. It is a cross-scale issue because (1) it involves jurisdictions, constituencies and management within and across countries, and (2) international legal, political, scientific, and technical activities causing emissions of hazardous chemicals (Selin, 2010). MacLeod et al. (2014) show in their research that the cross-scale perspective of chemicals management is ignored in current chemical policies. Selin (2010) also states that the chemical pollution issue, which he calls for chemical regime, has not been a study interest in global governance studies.

There are scientific connections between environmental toxicants and diminishing populations of wildlife (Oaks et al., 2004; Tapparo et al., 2012) and increasing burdens of human clinical and subclinical illness (Grandjean & Landrigan, 2006; Stillerman et al., 2008; WHO & UNEP, 2013). In a world where the use of chemicals only continues to expand, the release of harmful chemicals poses a risk for both ecological degradation and decrease in health and well-being among the human population. To a large extent the people most exposed to chemical risks are not the ones consuming the product or good, it is the ones who works for example in agriculture, manufacturing and waste recovery. These working sectors are interconnected to risks regarding environmental and human health, and the international trade of chemicals, goods, and wastes (Honkonen & Khan, 2017; Selin, 2010).

Chemical pollution is a governance challenge for several reasons. Firstly, there is no approach to how and what to quantify. Secondly, the governance frameworks in place cannot efficiently navigate society to avoid reaching the tipping point for how much pollution the environment can absorb without resulting in environmental degradation. Thirdly, in regards of chemical pollution there is no systematic effort at regime creation (Dimitrov et al., 2007; Lyanguzova, 2017). The third challenge is the one of interest in this study because it discusses how to form collaboration between the institutions involved in the chemical pollution issue. This is important to understand how to create synergies between institutions, strategies and policies so that the different levels strengthen each other. Among the scholars investigating Earth System Governance there is a joint standpoint that the governance needs to be improved and applied in policymaking (Walker et al., 2009). When reviewing the literature, a pattern was visualised, a mere part of the empirical cases had focused on only one institution (Aldy & Stavins, 2007; Barrett & Toman, 2010; Sugiyama & Sinton, 2005; Honkonen & Khan, 2017).

The chemicals regime needs to ensure environmental and human health protection (Faure & Lefevere, 2005; Underdal, 2008). According to Chambers (2008) all institutions involved in the chemical pollution issue needs to be included in the regime, and they need to be included in the decision-making process for the developing and implementing of suitable policies within and across scales. Honkonen & Khan (2017) shares Chameres’s (ibid.) standpoint regarding the importance of study the institutional linkages which they point out as a research gap. The studying of collaboration between states and non-governmental organisations (NGOs) in the chemical’s regime have been under the lens for decades, when it comes to how

1 Man-made chemicals are referred to at the substances not found naturally in the environment, the occurrence is a result of human activity.

2 External costs are an estimated cost on the societal and environmental costs the chemical pollution emissions are generating.
the collaboration affect the governance efforts to achieve a sustainable chemical management however have not been studied in-depth. Honkonen & Khan (2017) pays attention to this gap and mean that by studying policy issues and management experiences it can lead to analytical and policy-relevant insights of the impact the growing institutional density in global governance.

2.2 Policies on chemical pollution for sustainable chemical management – UN and Sweden

In the work on creating a toxin free environment a range of policies on different institutional levels has been developed. On a global level one policy of central importance is Agenda 2030 (United Nations, 2015), which is the agenda for sustainable development established by the United Nations. The agenda has been agreed on globally, but the commitment is voluntary and without consequences if not reaching the goals. In the Agenda 2030 it was recognised that three pillars; economic growth, social inclusion and environmental protection are needed to achieve a sustainable development. These elements are interconnected, and all are crucial for the well-being of individuals and societies. The agenda contains seventeen sustainable development goals (SDGs) and 169 targets. All SDGs are linked to sustainable chemical management because chemicals and chemical waste are present in almost all aspects of development. Four SDGs mentions chemical management explicitly, see below.

SDG 3 on Good Health and Well-Being emphasises that to ensure human health the protection from hazardous chemicals is crucial because it contribute to death and illnesses through the pollution.

- **Target 3.9:** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination

SDG 6 on Clean Water and Sanitation address the importance of sustainable chemical management to ensure a good quality of the drinking water for all, and access to sanitation.

- **Target 6.3:** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

SDG 12 on sustainable production and consumption emphasises the need for environmentally sound management of chemicals and waste.

- **Target 12.4:** By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment
- **Target 12.5:** By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

SDG 14 on sustainable life below water aims to protect marine and costal ecosystems from pollution.

- **Target 14.1:** By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

Honkonen & Khan (2017) state that the SDGs and policies on chemical management need to be seen together to achieve a sustainable development. The scholars suggest a more progressive approach cross institutions which includes the planning, priority, and strategy phases of each decision about harmful chemicals. On a national level in Sweden the work for a toxin free environment started before the
establishment of Agenda 2030 and the SDGs. The national policy is named national environmental quality goals and consists of sixteen goals, the one of interest in this study is the goal a toxin free environment. There are linkages between the SDGs and the toxin free environment goal when comparing the overarching objectives. The SDGs as presented above visualise a sustainable future only possible if the pollution of harmful chemicals is not affecting human health, the marine life, the drinking water quality or the ability to sanitation. The national non-toxic goal presents a vision of a society and environment free from toxins. The policy describes how the nature needs to be viewed, and that there are limits in the environment which is connected to stress on ecosystems from a chemical pollution perspective. The Non-Toxic Environment goal says that substances released into the environment shall not pose a threat to human health or the biological diversity. When the goal was established the aim was for the goal to be reached by year 2020, within one generation. This is one of the national goals Sweden will not reach by 2020. According to the governmental monitoring of the progression of the environmental quality goals there is a knowledge gap regarding the toxicology of all substances on the market. To achieve the goal the information transfer, substitution and effective control means are needed (Swedish Environmental Protection Agency, 2019).

Sweden is recognized as a country that has come a long way with their sustainability work, and the Swedish Government have the ambition to take the lead in implementing Agenda 2030. In their national action plan Sweden and the 2030 Agenda—Report to the UN High Level Political Forum 2017 on Sustainable Development they state that municipalities, county councils and regions play key roles for the achievement of the agenda (Ranängen, Cöster, Isaksson & Garvare, 2018). Ranängen and her colleagues claims that to achieve the SDGs in Agenda 2030, the goal must be recognized as interlinked and interdependent across sectors, societal actors and countries, i.e. a scale and cross-scale perspective. The municipalities in Sweden are decentralized from the national power, meaning that the municipalities can go further than the national legislations, if they have the support of their local politicians in charge. One example where municipalities can go further than the national legislations is in public procurement where the municipality can demand a higher level of sustainability in the products they will buy, if the demands placed are disabling the free competition. On a local level the work for a Non-Toxic Environment the municipalities in Sweden are at different states. Some of the municipalities do not have a chemical plan or a strategical approach to integrate the chemical perspective in the local work. Other municipalities have come a long way and have developed a strategical plan to achieve the goal.
3. Theoretical framework

The chapter explains the theoretical basis applied to answer the research questions. First the Earth System Governance theory with a focus on Governance Architecture by Frank Biermann is explained. Followed by scales and levels and ends with how the first two is incorporated in the used analytical framework.

3.1 Governance, Earth System Governance and Governance Architecture

The definition of governance applied in this thesis is the one by Candel & Biesbroek (2016) as the body where politics are formed. Within each governance policies are constituted and targets the specific governance. The different governance systems are often isolated from each other hindering a holistic approach which according to Jochim & May (2010) is needed to counteract environmental issues of cross-cutting nature. The different governances within the arena of chemical management is referred to as institutions in this study. The reason for using the term institutions and not governance is that it is the term used within Governance Architecture which is one of the two approaches which constitutes my analytical framework. The research angle is to study governance from an Earth System Governance (ESG) perspective.

The essence of the ESG theory is to distinguish the multi-institutional and cross-sectoral character of the studied system, from the interaction among the institutional governments in the system. Yet, cross-scale studies including several institutions among policy theorists are rare (Biermann et al., 2009a; Page, 2013). The ESG is a paradigm developed by Biermann (2007) and is to be understood as the interface of two broad strands of academic inquiry: Earth System analysis and Governance theory. ESG was refined through the Earth System Governance Project (Biermann et al., 2010), where the analytical problems of ESG were investigated and an analytical framework was constructed. ESG bridges traditional levels of analysis in governance and policy studies (Biermann, 2007) and is applied in the transdisciplinary fields of Earth System science and sustainability science (Biermann et al., 2009a). ESG focuses on questions of policymaking in regards of institutional performance, effectiveness, accountability and legitimacy. It includes all levels of governance, from local to global (Alexander et al., 2018; Biermann & Gupta, 2011; Carraro & Jongen, 2018; Gupta, 2010a, b; Mitchell, 2011). The ESG recognises that the earth has certain planetary limits\(^3\) and that there is a need to develop governing mechanisms to steer the human impact on planetary systems in the different institutions, so that these limits are not exceeded (Biermann, 2012).

A common angle for the institutional research in the field of ESG is to focus on a single institution, the most explored is international institutions in relation to legislations and international agreements (Biermann et al., 2009b). The research on Governance Architecture has mainly focused on single institutions over the past 40 years (Gupta & Falikner, 2006; Haas et al., 1993; Keohane & Levy, 1996; Miles et al., 2002; Victor et al., 1998; Young et al., 1999). For the last 20 years the understanding of the importance of including all the involved institutions has grown (van Asselt et al., 2005; Chambers, 2001; Helm & Sprinz, 2000; Mitchell, 2003; Oberthür and Gehring, 2006; Rosendal, 2001a, b; Stokke, 2000; Velasquez, 2000; Young, 2001).

Biermann et al. (2007) have constructed the ESG framework, which I apply in this study. The framework has been operationalised in several studies from different perspectives, e.g. in relation to democracy (Baber & Bartlett, 2009; Dryzek & Stevenson 2011; Sonnenfeld & Mol, 2011) and how transparency, accountability and effectiveness of multilevel environmental governance arrangements is affected by each other (Alexander et al., 2018; Carraro & Jongen, 2018; Gupta, 2010a, b; Mitchell, 2011). Within the ESG framework, Biermann et al. (2007) identified five analytical problems. These are the issue of (1) architecture, (2) agency beyond the state, (3) adaptive governance and the ‘adaptive state’, (4) accountability and (5) allocation.

In this study I focus on the issue of architecture, which Biermann et al. (2009b) calls Governance Architecture. The authors define Governance Architecture as the intertwining web of (1) institutions, (2) widely shared principles and (3) practices that affects decisions by stakeholders at all levels. Biermann (2008) defines institutions as clusters of rights, rules, and decision-making procedures involved in

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\(^3\) Planetary limits are a part of the Planetary boundary framework by Rockström et al. (2009a). The framework set precautionary limits to human impact on several Earth system processes in order to ensure a safe operating space for humanity.
fragmentation of the governance work to in this case achieve a toxin free environment. Shared principles are either (1) universally accepted constitutional principles, or (2) principles of common but differentiated responsibilities. Practices are referred to the participants roles which creates interactions among players within and across the institutions.

To form decisions that on all institutional levels lead to a toxic-free environment, it is important to identify: (1) the synergies for interplay and interaction and (2) the conflicts between the complexes and constellations (Biermann, 2007). My motivation for focusing on Governance Architecture is that it helps to conceptualise the hindering and facilitating mechanisms in the studied issue. The conceptualising is basing on how institutions, principles, norms, regulations, decision-making procedures and organisations are connected (Biermann et al., 2007). By studying Governance Architecture the question of how to optimise cross institutions can be understood. This is important to be able to answer the research questions on (1) the hindering & facilitating mechanisms to achieve sustainable chemical management in Sweden from a cross-scale perspective, and (2) the role of scale and Governance Architecture for policy integration. This approach helps to identify where the trade-offs are between the different institutions, and how the vertical institutional interaction impacts the trade-offs.

Biermann et al. (2007) presented four crosscutting themes crucial for the integrated understanding of Earth System Governance hence, to deal with the five analytical problems in the ESG framework. These are the role of power, knowledge, norms and scale. Power shapes which norms of allocation are selected, articulated and implemented. When studying power, it is important to study how it affects allocation. Knowledge involves different types of knowledge, i.e. political, technical and scientific, which will affect the generated knowledge received. When studying knowledge, it is important to relate the knowledge to the agency producing the knowledge. Norms are relevant at all levels of decision-making in ESG. It is an integral part of the architecture. When studying norms, it is important to ask how agency can affect the adaptiveness. Scale is defined as the spatial, temporal, quantitative and analytical dimensions used to measure or rank any phenomenon. Scale is the crosscutting theme of focus in this study because it enables investigating the research questions from a cross-scale perspective.

Governance Architecture is a response to the debates on strengthening the UN system in field of Earth system science, specifically regarding sustainable policy making (Biermann & Bauer, 2005; Reckhemmer, 2005). Previous studies on Governance Architecture explores the concept from several angles. Dombrowski (2010) investigate how the roles of NGOs can fill some of the gaps in the global climate governance theory. Clark et al. (2001) and Galaz (2009) focus on international institutions and their administrative bodies to investigate the conditions for knowledge and information transfer. Another research angle was to apply architecture to gain a better understanding of policy integration (Biermann et al., 2009b). A common approach in the literature is to focus on one institution at the international level (Aldy & Stavins, 2007; Barrett & Toman, 2010; Sugiyama & Sinton, 2005).

3.2 Scales and levels

Scale and cross-scale dynamics are important to include in social and environmental policies (Cash et al., 2006; Cosens & Gunderson, 2018; Folke, et al., 2002). A number of scholars have stated that a scale and cross-scale perspective is needed in the governance approach to get a more in-depth understanding of what is affecting the creation of sustainable regimes (Armitage, 2008; Beckers, 2006; Cash et al., 2006; Termeer et al., 2010; Young, 2006; Wilson, 2006). Scale and cross-scale dynamic are not constant, the dynamic differs in each situation and involves different scales depending on the context. Scale and cross-scale dynamics can help understand to what extent scales are influencing the findings, to identify the scales and levels, and how the scales and levels are integrated (Biermann et al., 2009b). Interactions on a cross-level among different regimes occurs when there is a vertical interplay among and between regimes that are situated on different levels on the scale (Young 2006). Level is the unit of analysis located at different positions on a scale (Biermann et al., 2009b).

In previous scale studies, there was clear focus on spatial, temporal, and jurisdictional issues (Cash et al., 2006). Spatial issues are explored by studying how and on which premises a phenomenon occur, if it is based on environmental, geophysical and/or ecological elements. Temporal issues are studied to understand how the phenomenon fluctuated over time to understand when the hindering and facilitating mechanisms are the strongest. This is important to gain understanding where the weak links in the studied
chemical regime lies. Jurisdictional issues most explored are the political units, where cases regarding the chemical regime are commonly used. The chemical regime in these cases are the occurrence of a specific harmful chemical in a certain area and how jurisdiction is affecting the regime (Ditz & Tuncak, 2014; Kok et al., 2001; Kok & Veldkamp, 2011; Kumar, Kaushik & Villarreal-Chiu, 2016; Kummer, 2014).

In the literature on the framework by Cash et al. (2006) it is perceived as a framework to diagnose barriers within the studied phenomenon to understand the existing scale challenges (Vervoort et al., 2012). This is in line with the purpose of this study. Cash et al. (2006) define scale challenge as “a situation in which the current combination of cross-scale and cross-level interactions threatens to undermine the resilience of a human-environment system.”. They found that ignorance, mismatch and plurality are the cause of scale challenges. Ignorance represents the lack of knowledge of key processes within and across scales. Mismatch recognises that the scales incorporated into the decision-making process often affect other system dimensions in unintended and destructive ways. Plurality means that there are several scale perspectives, which affect what is included in the analysis. To overcome this, Cash et al. (ibid.) suggest that the society needs to recognise all scales and levels included in the problem, and stress on the importance that these interact. The authors highlight that in certain cases, a study would benefit from adding the institutional, management, network and knowledge scales. In some cases, these are important to incorporate, in other cases they might be ‘scale free’. For example, regarding management, the challenges related to mismatches may not have so much to do with space as with response and change in the management scale.

Cash et al. (ibid.) propose seven scales that are present in different levels located at different positions on each scale (see Figure 1). All seven are included in my study. These are the spatial, temporal, jurisdictional, rule, management, networks and knowledge scales. The spatial scale represents the geography, the physical locations affecting or is affected by the phenomenon. The temporal scale includes the rate and frequencies of a phenomenon. The jurisdictional scale is clearly bounded and organised political units, e.g., towns, counties, states or provinces, and nations, with linkages between them created by constitutional and statutory means. The rule scale has jurisdictional characteristics but also fall into a hierarchy of rules, ranging from basic operating rules and norms, to systems of rules for making policy decisions. The management scale describes the hierarchical sets ranging from tasks through projects and strategies. The network scale shows the mechanisms to develop appropriate cross-level mechanisms of interplay. The knowledge scale is the different types of information affecting the decision-making.

Scales and levels can interact in different ways, in cross-level interactions for example there are interactions between levels within a scale. Cross-scale refers to interactions across different scales. These interactions can change in strength and direction over time, due to the interactions or by influence of other scale variables (Cash et al., 2006). I have applied the scale theory to identify the interactions within and
across scales, i.e. cross-level and cross-scale. The purpose of using this theory is that it helps gain an understanding how scale challenges are present within chemical management policies. I have mapped the interactions within and cross the four scales from the empirics. First, I categorized the empirics under each scale, then I studied how the scales connected to each other. Figure 2 shows the five different types of scale interaction which I have applied in the analysis of the empirics.

- **A** shows multi-level single scale, this means that within one scale several levels are placed, but the levels are not integrating.
- **B** is also a single-scale but cross-level, meaning that interaction between the levels are present.
- **C** is two scales, each consisting of several levels, but the levels are not interacting.
- **D** is two scales where interaction is present within each scale, i.e. cross-level interaction.
- **E** is two scales where interaction is present within each scale and between the two scales, i.e. cross-level and cross-scale interactions.

![Figure 2. Schematic illustrations of interaction on a cross-level, cross-scale, multilevel and multiscale. Adapted from Cash et al. (2006).](image-url)

### 3.3 Analytical framework for this study

The analytical framework used in this study bases on the analytical problem of *Governance Architecture* within the ESG framework. The ESG framework describes how to rank or measure the studied phenomenon by viewing the issue from a spatial, temporal, quantitative and analytical dimension (Biermann *et al.*, 2009a, b). Cash *et al.* (2006) provides a tool for how to operationalise these dimensions where they recognise the spatial and temporal dimensions as two of the seven scales. The authors are basing the scale dynamics on the quantitative and analytical dimensions. The constructed framework was based on the three core elements proposed by Biermann *et al.* (2007) to be the key influencer of sustainable decision-making. The elements are (1) institutions, (2) widely shared principles and (3) practices. If the dynamic within one of these three
elements are changed it will affect the other two. This is illustrated in the arrows between the three elements in Figure 3. The vertical arrow named ‘cross-scale’ illustrates the interactions between the identified institutions, shared principles and practices across the scales. In the bottom of the figure the facilitating mechanisms are shown, these are influencing the creation of a sustainable chemical management. The created analytical framework is used to identify the hindering and facilitating mechanisms for collaboration within and cross-scales to create sustainable chemical management.

**Figure 3.** A conceptual framework for analysing how to achieve sustainable chemical management. The framework is based on the Earth System Governance framework (Biermann et al., 2009a), combined with other perspectives on scale challenges by Cash et al. (2006). Cash et al. (ibid.) adds to Biermann et al. (2009a) approach to study the scale dynamic, this is illustrated in the arrow named ‘cross-scale’, this includes the seven scales: spatial, temporal, jurisdictional, rule, management, network and knowledge, and is studied within and between the elements: institutions, shared principles and practices to gain understanding of how to create sustainable chemical managements.
4. Methods and materials

4.1 The study design

The data collecting consisted of policy documents and interviews. The documents were key governmental policies for achieving the two goal frameworks, i.e. Agenda 2030 and the national environmental quality goal a Toxin Free Environment, on a national level in Sweden. The interviewees were practitioners working with the studied governance policies. The material is described more in-depth in section 4.2. The policies were read several times with different depts. The first reading was to form an understanding which questions to focus the in-depth interviews on. The interview guide was semi-structured, this approach opens the door for the interviewees to add more aspects to the research question than the ones found in the written material (Justeen & Mik-Meyer, 2011). The questions were formulated in a way to make the interviewees talk about the identified mechanisms in the documents without knowing I wanted to discuss certain factors. The questions were open and non-standardised because of the same reason the semi-structure was applied. The essence was to gain understanding of the participants’ view of the research question. This form of interviewing is described by Hennink, Hutter & Bailey (2011) as “a conversation with a purpose”, that the purpose of the interviewing is for me as a researcher to get the interviewees’ perceived reality. The interviews were transcribed word for word.

The analysis of the interviews started with identifying the hindering mechanisms, followed by the facilitating mechanisms. From the categorisation of the mechanisms a second and third type of reading of the documents was conducted, using the categorises established from the interviews. The second reading has the purpose to find the sections describing the mechanisms the interviewees spoke of, these sections were then read in-depth twice. The collected empirics were analysed by using qualitative data analysis. The motivation for applying a qualitative research approach to answer the research questions is that it enables reasoning and evaluating complex problems to gain a detailed understanding of the studied phenomenon (Hennink, Hutter & Bailry, 2015; Ritchie & Spencer, 2002).

To answer the first research question regarding what the key hindering & facilitating governance mechanisms are, the starting point was to map the hindering mechanisms. The hindering mechanisms were categorised according the essence of Governance Architecture (Biermann et al., 2009b): (1) institution, (2) shared principle or (3) a practice. After identifying how the hindering mechanisms relate to the issue of Governance Architecture, the hindering mechanisms were then categorised based on what caused the hinder. The categories were (1) a scale problem, (2) an implementation problem or (3) a policy gap problem. After the categorisation of the hindering mechanisms the facilitating mechanisms were identified. The facilitating mechanisms gave suggestions how to form sustainable chemical management in Sweden on a national and municipality level. To answer the second research question on how scale and Governance Architecture could help policy integration was incorporated in the last step of the study design “Decision-making for sustainable chemical management” in Figure 4. The last step of the analysis was to view the material form a cross-scale perspective, looking at how the scale framing, scale dependency and cross-scale interactions was presented in the empirics.

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4 A request from a few participants was that their names would not be revealed. Since the focus of the study was to get different perceptions on where the conflicts are today and how to create synergies cross and within scales to create a Non-Toxic Environment in Sweden, and how Agenda 2030, their identities are not of key interest for this study. Confidentiality agreements were signed to create a safe talking environment, this to create trust so that they would feel safe to share their experiences.
4.2 Materials

The policies included in the study describe Sweden’s vision of a toxin free environment, which is one of the national environmental quality goals. The Swedish Chemicals Agency is supervisory authority under the government, they oversee the follow up of that goal. Three documents were included in this study: *Environmental quality goals (prop 1997/98:145)*, *Chemical strategy for A Non-Toxic Environment (Prop 2000/01:65)*, and *The way towards a chemical free everyday life – platform for the chemical politics (prop 2013/14:39)*. Sweden’s implementation of Agenda 2030 is described in three documents: *Implementation of Agenda 2030 for sustainable development, committee directives (Dir.2016:18)*, *Policy for global development in the implementation of the 2030 Agenda (Skr. 2017/18:146)*, and *Action plan for the Agenda 2030: 2018-2020*. In Figure 5 the connection between the documents is illustrated.

The two goal frameworks investigated

- Sweden’s national environmental quality goal A Non-Toxic Environment
- UN’s SDG in Agenda 2030

National policies for achieving the goal frameworks

- Environmental quality goals (prop 1997/98:145)
- Chemical strategy for A Non-Toxic Environment (Prop 2000/01:65)
- The way towards a chemical free everyday life – platform for the chemical politics (prop 2013/14:39)
- Implementation of Agenda 2030 for sustainable development, committee directives (Dir.2016:18)
- Policy for global development in the implementation of the 2030 Agenda (Skr. 2017/18:146)
- Action plan for the Agenda 2030: 2018-2020

The interviewees were selected based on following criteria: (1) They work with/or have developed the policy documents included in the study, and (2) they have practical experience from working with the
documents from a municipality, state authority, or governmental level. They were recognised as key persons with valued experiences of interest for this study. A snowball selection was used to find the most suitable people to interview. This was executed by conducting a literature overview to find the candidates, a few of them referred me to other people which I also invited to participate. On the municipality level the civil servants interviewed oversaw the local chemical work. On the national level one person was from the Swedish Chemical Inspection, one was from the Swedish Environmental Protection Agency and two from the Government Offices. Their connections to the Swedish goal a Non-Toxic Environment and/or Agenda 2030 are described below in Table 1. On the municipality level ten municipalities were invited to participate, three of them wanted to participate. These ten were chosen on the basis that they today work proactively, strategically and systematically with chemical management to achieve the goal a Non-Toxic Environment on a local level (Aktuell Hållbarhet, 2017). One interview was carried out face-to-face, the others were via Skype or phone. The time period for the interviewees were from January to February 2019. The interviews were recorded and then transcribed word for word. Each interview lasted for about 50 minutes.

Table 1. A description of the people included in the interview study.

<table>
<thead>
<tr>
<th>Employee at</th>
<th>Academic background and how they work with the goal a Toxin Free Environment and/or the Agenda 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>National level (1)</td>
<td>The participant has a degree in natural science with focus on biology and ecotoxicology. He/she has a long experience from working with chemical management within the agency. He/she has also worked with chemical issues on a municipality level. The participant works with the implementation and monitoring of the goal A Non-Toxic Environment, conducting risk assessments, proposals for decisions and communication. The levels he/she work on are the national, EU and global level.</td>
</tr>
<tr>
<td>National level (2)</td>
<td>The participant has a degree in civil engineering and industrial economy. He/she has worked at the Swedish EPA over ten years. Before he/she worked within the business world with production technique and marketing. The chemical perspectives worked with was a toxin free environment, toxin free waste, waste issues and resource issues. One of his/her job assignments are to provide data for the government to base their decisions on and provide suggestions on law legislations and how to solve different negations.</td>
</tr>
<tr>
<td>National level (3)</td>
<td>The participant has a degree biology and ecotoxicology, he/she has worked within the department over ten years. Earlier he/she has worked in the Swedish Chemical Inspection. During Sweden’s chairmanship in Brussels his/her focus was on chemicals. He/she worked on the Swedish chemical proposition, a strategy for how to implement the Swedish environmental quality goal A Non-Toxic Environment.</td>
</tr>
<tr>
<td>National level (4)</td>
<td>The participant has a degree civil engineering and civil economy and has worked in the Government Offices for over ten years. One of his/her focus has been on the UN negotiations on sustainable development and had a coordinating role in the Swedish action plan on achieving Agenda 2030.</td>
</tr>
<tr>
<td>Municipality level (1)</td>
<td>The participant has a master’s degree in chemistry and a one-year master’s degree in environmental science. He/she works at the Environmental Administration. Before starting the current position, he/she worked with pharmaceutical development. The past 1-5 years he/she has focused on sustainable consumption (SDG 12) where the goal A Non-Toxic Environment was a part of that work.</td>
</tr>
<tr>
<td>Municipality level (2:1)</td>
<td>The participant has a master’s in environmental science and has worked in two municipalities before starting the position at the municipality where he/she has worked with environmental issues for over ten years. He/she oversees the environmental strategical unit.</td>
</tr>
<tr>
<td>Municipality level (2:2)</td>
<td>The participant has a one-year master’s in chemistry and a PhD in environmental chemistry. He/she started the current position less than a year ago where he/she works</td>
</tr>
</tbody>
</table>

5 One of the interviewed municipalities had recently hired a person to focus on the chemical issues, who at the time of the interview had worked there a few months. I interviewed the person who had had worked with the municipalities chemical work, and the newly employed. This is because the first person had worked at the municipality for over 10 years and could give a good picture on the local work, and the newly employed who has expertise within environmental chemistry.

6 See comment above.
with the chemical the actions pointed out in the current chemical plan and other action plans connected to the chemical plan.

| Municipality level (3) | The participant has a master’s in chemistry and a PhD in water and society. He/she has worked over ten years with environmental issues related to chemical pollution within the city. The goal A Non-Toxic Environment is the foundation for his/her work. |
5. Results – Hindering and facilitating mechanisms for sustainable chemical management

In this chapter hindering and facilitating mechanisms for sustainable chemical management identified from the analysed documents and interviews are presented. The mechanisms were categorised based on the three elements of architecture, i.e. institutions, shared principles and practices. In the next sub-sections, the results are presented according to how they relate to (1) scale gaps, (2) implementation gaps and (3) policy gaps. The identified institutions were the same for both interviews and analysed documents: (1) civil society, (2) local governments, (3) national authorities, (4) national government, (5) EU government and (6) global government. In the documents Sweden and EU were recognised as the most important institutions to create a toxin free environment. The work for a toxin free environment on the local governments and civil society levels however were important for the goal to be reached on the regional, national and international levels. Emphasis was put in both Agenda 2030 and the national environmental quality goal A Non-Toxic Environment that commitment across all institutions is required to create a toxin free environment. The focus on Sweden and EU was shared by the interviewees from the national authorities and the national government. For the interviewees on the municipality level the focus was on the local, national and EU institutions.

5.1. Scale challenges

From a scale and cross-scale perspective scale challenge poses a hinder for sustainability, this is because the pollution issue involves several geographical, jurisdictional and institutional levels. To create a toxin free environment a joint stand in the material were that all involved institutions, scales and levels affected by and causing chemical pollution needs to collaborate. To reach collaboration the isolation between institutions, caused by (1) power imbalances, (2) a top-down structure, (3) authority, jurisdictional and hierarchal limits, (4) conflicts of interests need to be solved and (5) reductionism needs to be dealt with. The hindering and facilitating mechanisms are presented in Table 2, together with a quantification of which documents and interviewees spoke of the different mechanisms.

The EU governance has a larger power than the lower placed institutions, i.e. the national and local levels. The interviewees spoke of a dependence on the politicians, i.e. the jurisdictional scales, in regards of getting mandate to work with the achievement of a toxin free environment. The political forces in charge were an important hinder limiting the work to create sustainable chemical management. Power imbalances was mentioned in one document and by five of the interviewees which stated that legislation and jurisdictions uphold the current power structure. Power structure as a concept used in this thesis includes the jurisdiction and mandate to decide which affects other institutions’ ability to create sustainable chemical management. Two of the interviewees recognised that the isolations between the institutions is a result of the power structure. These two interviewees believed that collaboration could be reached if the Swedish government would listen to what the municipalities need to be able to work with the goal in practice.

Both the documents and the interviewees viewed power imbalance as a result of the current top-down structure. The top-down approach poses a hinder to the creation of a toxin free environment because the development is dependent on the politicians’ interest in the pollution question. A facilitating mechanism mentioned by the interviewees and in one document to create collaboration cross institutions was to create trade-offs between and within the affected scales. By locating where the trade-offs lie an understanding can be gained of how to form decisions leading to the achievement of the non-toxic goal.

The current jurisdiction, authority and hierarchy structure were presented as a scale challenge in five of the analysed documents and by three interviewees on the national level and two on the municipality level. Institutions were described as bound to the jurisdictional structure in form of limits to act outside of the jurisdiction they work within. Authority limits as a hinder which hinders an institution to work with a certain project because they lack the mandate. One interviewee on the municipality level said he/she wants to take certain measures to achieve the non-toxic goal on the local level, but the local elected politicians do not give them the authority to start the project. This example illustrates a collaboration issue within an institution. According to this interviewee the politicians need to overcome the knowledge gap that the chemical issue is an important societal issue. The hierarchal structure was presented as a cross institutional
issue, meaning that the EU-institution limits Sweden’s ability to achieve a toxin free environment. This limitation occurs because the current EU legislation weakens the lower placed institutions’ possibilities to achieve a toxin free environment.

One document and all the interviewees on the national level and three on the municipality level viewed conflicts of interests within and cross institutions as a practice that hinders sustainable chemical management. Examples were mentioned of self-experienced cases where conflicts of interest have hindered the achievement of a toxin free environment. One from the national level said that within the European Union the chemical issue is not viewed as an important issue by all countries. One reason for the different views on chemicals as a sustainability issue he/she believed was that the countries within the European Union are at different stages of dealing with the pollution issue. Because of this difference in how far the countries have come the view of what is an important pollution issue differs. From his/her experience Sweden’s vision of a toxin free environment is viewed by other countries as too ambitious and focusing on small problems within the nation while other countries have larger pollution issues to deal with. This struggle between taking the next step while other countries are just starting to deal with their pollution issues presented as an important hinder. On the municipality level the conflict of interests was on the local level and involved the support of the local politicians, i.e. that they do not view the chemical issue as an important sustainability problem. Examples were made by the interviewees on both levels that to create a toxin free environment the institutions involved need to collaborate and recognise the pollution issue as a joint problem. Collaboration and sharing experiences were identified as facilitators to overcome the issue of conflicts of interests.

Two interviewees on the national level and two on the municipality level expressed that the chemical management is based on reductionism. They meant that the different institutions have an end of pipe approach when working with tasks and projects on the chemical pollution issue. The ones on the municipality level had experiences of the government assuming what is needed on the municipality level to achieve a toxin free environment, without asking the ones working on the municipality level. Preconceptions for how things work was described as a result of a reductionist approach, focusing on assumptions rather than facts. In the current power structure, consisting of authority, jurisdictional and hierarchal limits, five of the interviewees spoke of separated responsibilities. By creating collaboration and sharing knowledge and experiences cross institutions conflicts of interest and reductionism could be solved. Collaboration requires dialogue and the involvement of all actors involved in the chemical pollution issue stated three of the interviewees.

To listen and learn from each other’s experiences could help solve the isolations between decisions based on theoretical thinking on the national governance level, and implementation of these decisions in practice on a local governance level. The interviewees saw occurrence of isolations between institutions as a result from the dominating top-down approach and hierarchal structure in the politics affecting the legislations and strategies for a toxin free environment. The facilitating mechanism to counteract the previously mentioned isolations was collaboration and vertical interplay cross institutions, which was mentioned in both the documents and by the interviewees. Collaboration cross institutions was presented as a key to overcome the scale challenge of chemical pollution. The dynamic presented was that the EU and global institutions set the chemical agenda. Sweden has a limited possibility affect the agenda on an EU and global level, but can affect the agenda on a national, municipality and civil society level.

Reductionism is one approach to gain understanding the studied system, you study a small part of the system from which you draw conclusions from. The opposite is systemic/holistic approach (See Kieth et al., 2015).
Table 2. The identified hindering and facilitating mechanism in the current chemical management from a scale challenge perspective. The table shows the theoretical level which includes the analysis of policies, and a practical level where individuals who work with the implementation of the policies have shared their experiences through in-depth interviews. The categories (1) institutions, (2) shared practices and (3) principles are key elements in Governance Architecture which was the applied theory in this study. \textit{n}_{mechanism} shows the number of documents and interviewees who spoke of the mechanism.

<table>
<thead>
<tr>
<th>Fragmentation caused by scale</th>
<th>Reviewed documents</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Institutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindering (creating the problem)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanism</td>
<td>\textit{n}_{mechanism}</td>
<td>\textit{n}_{mechanism}</td>
</tr>
<tr>
<td>Isolations between institutions</td>
<td>Prop. 2000/01:65 Fi. 2018:3</td>
<td>National: 3 Municipality: 3</td>
</tr>
<tr>
<td>The EU governance the largest power over the lower placed institutions, i.e. the national and local governances</td>
<td>Prop. 1997/98:145 2013/14:39</td>
<td>National: 3 Municipality: 2</td>
</tr>
<tr>
<td>Facilitating (solving the problem)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanism</td>
<td>\textit{n}_{mechanism}</td>
<td>\textit{n}_{mechanism}</td>
</tr>
<tr>
<td>Vertical interplay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Shared principles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large focus on legislation &amp; strategies, a clear top-down structure</td>
<td>Prop. 1997/98:145</td>
<td>National: 3 Municipality: 2</td>
</tr>
<tr>
<td>Authority, hierarchal and jurisdictional limits</td>
<td>Fi 2018:3 2017/18:14 Prop. 2000/01:65</td>
<td></td>
</tr>
<tr>
<td>Facilitating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-institutional collaboration</td>
<td>Dir. 2013:8</td>
<td>National: 2 Municipality: 2</td>
</tr>
<tr>
<td>3. Practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reductionism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facilitating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration and sharing experiences</td>
<td>Dir. 2013:8</td>
<td>National: 3 Municipality: 3</td>
</tr>
</tbody>
</table>

5.2 Implementation challenges

Implementation becomes an issue when the policies to create a toxin free environment are in place but are not implemented to achieve the goal among the lower placed institutions. The occurrence of this problem fragmentation caused by (1) a reductionistic view and (2) authority, jurisdictional and hierarchal limits the participants believed to be the result of implementation issues. The hindering and facilitating mechanisms are presented in Table 3, together with a quantification of which documents and interviewees spoke of the different mechanisms.

The interviewees expressed that the policies investigated assume that the institutions involved in the achievement of the non-toxic goal have the tools needed to work with the goal. This standpoint represents a reductionistic view. The local governance is given specific tasks from the national level to work with the chemical issue locally, but they are not given the tools needed to work with these tasks. One of the interviewees used a football metaphor:

We are given a task to work for a toxin free environment in the local procurement (In Swedish: offentlig upphandling) without giving us the tools to work with the issue in practice. It is a chance ball that disappears in the thin air. From the national level we are expected to work with the task, but it is not
The collaboration between the local and national governances in this example is not working optimally. The participants from the local governance experienced barriers for working with the achievement of a Non-Toxic Environment caused by the national level. The people working within a national authority experienced several barriers between other national authorities and/or the national government. The person who worked at the national government experienced barriers between Sweden and European Union. He/she stated that Sweden are ambitious and want to do more but are restrained by the European Union. This is another exemplification of the issue of reductionism. Coordination within and between institutions was presented by both the documents and interviewees as a facilitator for the implementation process to achieve a toxin free environment in practice. An integrated approach was also seen as a facilitator, this approach combines top-down and bottom-up actions to create unity across the jurisdictional levels, increasing the opportunities for proactive work. This approach was by two documents and six interviewees believed to increase the opportunities for synergies.

The dependence on other institutions for achieving a toxin free environment six of the interviewees stated as an effect of the presence of jurisdictional borders and lack of mandate. The participants presented that the issues of hierarchy and authority were caused by jurisdictional restrictions between the involved institutions. One document and four of the interviewees believed that by creating a joint vision the hinders of jurisdictional and mandate character could be solved. The four interviewees said that a common vision within and cross institutions also could help a larger part of the Swedish society to understand the importance of the chemical issue. The participants stated that the action plans for a toxin free environment, which is a long-term goal, needs to be handled by the politicians like it is a common goal and not just something that looks good on paper.

Table 3. The identified hindering and facilitating mechanism in the current chemical management from an implementation challenge perspective. The table shows the theoretical level which includes the analysis of policies, and a practical level where individuals who work with the implementation of the policies have shared their experiences through in-depth interviews. The categories (1) institutions, (2) shared practices and (3) principles are key elements in Governance Architecture which was the applied theory in this study. The columns marked with an ex the documents only spoke of what is needed for sustainable chemical management, without polemising what the hindering mechanism were. nmechanism shows the number of documents and interviewees who spoke of the mechanism.

<table>
<thead>
<tr>
<th>Fragmentation caused by implementation</th>
<th>Reviewed documents</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Institutions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindering (creating the problem)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Coordination</td>
<td>Fi. 2018:3</td>
<td>• Reductionism National: 4</td>
</tr>
<tr>
<td></td>
<td>Dir. 2013:8</td>
<td>Municipality: 1</td>
</tr>
<tr>
<td>Facilitating (solving the problem)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• An integrated approach</td>
<td>Prop. 1997/98:145</td>
<td>• An integrated approach to gain a holistic understanding National: 2</td>
</tr>
<tr>
<td></td>
<td>Fi. 2018:3</td>
<td>Municipality: 4</td>
</tr>
<tr>
<td></td>
<td>Dir. 2013:8</td>
<td></td>
</tr>
<tr>
<td>2. Shared principles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Jurisdictional borders and mandate</td>
<td></td>
<td>National: 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Municipality: 3</td>
</tr>
<tr>
<td>Facilitating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• A common vision is needed</td>
<td>Prop. 1997/98:145</td>
<td>• A common vision of how to achieve a toxin free environment within Sweden is needed National: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Municipality: 2</td>
</tr>
<tr>
<td>3. Practices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Jurisdictional restrictions between the institutions caused by hierarchy and authority.</td>
<td></td>
<td>National: 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Municipality: 2</td>
</tr>
<tr>
<td>Facilitating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Joint responsibility across the political levels</td>
<td>Prop. 1997/98:145</td>
<td>• Joint responsibility across the political levels to achieve a toxin free environment National: 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Municipality: 2</td>
</tr>
</tbody>
</table>
5.3 Policy gap challenges

A problem due to gaps in policy were described as the case when policies are counteracting each other or hinders positive synergy effects between the policies. Fragmentation due to policy gap challenges were caused by (1) authority, jurisdictional and hierarchal limits, (2) a top-down approach, (3) focus on the economic dimension of SD, (4) asymmetric information and (5) short term-sustainability. The hindering and facilitating mechanisms are presented in Table 4, together with a quantification of which documents and interviewees spoke of the different mechanisms.

A dependence of the higher placed institutions was identified by one document and four interviewees. The dependence the participants described as a result of the current authority, jurisdictional and hierarchal limits, which have a dominating top-down approach. Isolation between legislations and policies five of the interviewees identified as an important hinder to counteract. Management in form of policies together with legislation could be a possible creator of synergies, the key presented was policy integration. Four of the interviewees mentioned that by including the chemical issue in the sustainability issue the policies and legislation would create better possibilities to achieve the non-toxic environment goal in practice. One suggestion was that sustainability and chemical management should not be seen as two separate bodies, that the sustainability requirements need to include chemical requirements. One of the interviewees on the municipality level stated that the sustainability discourse is not including enough of the chemical discourse, which is a limitation to achieve sustainable chemical management. He/she exemplified this by saying that when talking of the chemical issue on a national level the focus is on certain measures and processes, but when talking of these processes the chemical issue perspective not included in the discussion.

The asymmetric information between the producer and consumer presented as a hinder by five of the interviewees and in three of the documents. One participant stated that information is the foundation for the market economy, but it does not apply for chemicals because there is not enough information to make rational decisions. The global trade both the documents and interviewees viewed as a limitation due to the complexity of the supply chains in the production today, but it could become a facilitator if the production would focus on sustainable production. One participant identified the market as a hinder, that there are great powers that want to keep their chemicals on the market because it generates enormous amounts of money. Four of the interviewees believed that the economic dimension could be a facilitating mechanism and could fix the error of asymmetric information. The interviewees stated that it requires a market based on fair play rules regarding information access and ability to work for the achievement of the goal in practice. Also, coherence between the trade and environmental legislations is needed.

Short-term sustainability thinking in the political assignments was presented as a hinder by one of the documents and four of the interviewees. An interdisciplinarity approach in the decision-making process seven of the interviewees presented as a possible facilitating mechanism to counteracts short-term sustainability thinking. The network and knowledge scales can act as a facilitating mechanism because informing sharing increases the knowledge of chemicals risks. Increased knowledge creates better opportunities to make informed consumption decisions, the success is dependent on an increase of the general knowledge and the knowledge needs to be based on science. Another facilitating mechanism was to strengthen scientific knowledge across the institutions, this was found in three of the documents and mentioned by four of the interviewees. Interdisciplinarity and knowledge was presented as interlinked. The document and the four interviewees also stated that the sustainability work needs to be based on the three dimensions of sustainability, i.e. to create equal and sustainable societies and a circular and bio-based economy.
Table 4. The identified hindering and facilitating mechanism in the current chemical management from a policy gap perspective. The table shows the theoretical level which includes the analysis of policies, and a practical level where individuals who work with the implementation of the policies have shared their experiences through in-depth interviews. The categories (1) institutions, (2) shared practices and (3) principles are key elements in Governance Architecture which was the applied theory in this study. \( n_{\text{mechanism}} \) shows the number of documents and interviewees who spoke of the mechanism.

<table>
<thead>
<tr>
<th>Fragmentation caused by policy gap</th>
<th>Reviewed documents</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Institutions</td>
<td>Mech.</td>
<td>( n_{\text{mechanism}} )</td>
</tr>
<tr>
<td>Hindering (creating the problem)</td>
<td>Authority, jurisdic-</td>
<td>Fi. 2018:3</td>
</tr>
<tr>
<td></td>
<td>tional and hierarchal limits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The dominating top-down approach</td>
<td>National: 3</td>
</tr>
<tr>
<td></td>
<td>• Isolation between legislations and policies cross-scale</td>
<td>National: 2</td>
</tr>
<tr>
<td>Facilitating (solving the problem)</td>
<td>Overlapping policies, for example circular economy and Agenda 2030</td>
<td>Fi. 2018:3</td>
</tr>
<tr>
<td></td>
<td>• REACH and other legislations, such as circular economy.</td>
<td>National: 2</td>
</tr>
<tr>
<td></td>
<td>• Sustainability policies are not including the challenge of chemical pollution</td>
<td>National: 1</td>
</tr>
<tr>
<td>2. Shared principles</td>
<td>Mech.</td>
<td>Prop. 1997/98:145</td>
</tr>
<tr>
<td></td>
<td>• The global trade is a hinder due to the asymmetric information between the producer and consumer.</td>
<td>Prop. 2000/01:65</td>
</tr>
<tr>
<td></td>
<td>Prop. 2013/14:39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Market mechanism</td>
<td>Prop. 1997/98:145</td>
</tr>
<tr>
<td></td>
<td>• The legislation needs to enable fair play rules regarding information access and ability to work for the achievement of the goal in practice</td>
<td>Prop. 2000/01:65</td>
</tr>
<tr>
<td></td>
<td>Fi. 2018:3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dir. 2013:8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Coherence between the trade and environmental legislations</td>
<td>National: 2</td>
</tr>
<tr>
<td></td>
<td>• The economic dimension is the key, need to fix the error of asymmetric information and knowledge of substances toxicity</td>
<td>National: 2</td>
</tr>
<tr>
<td></td>
<td>• Short-term sustainability</td>
<td>Prop. 2000/01:65</td>
</tr>
<tr>
<td></td>
<td>Fi. 2018:3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Interdisciplinarity</td>
<td>National: 4</td>
</tr>
<tr>
<td></td>
<td>• The work needs to base on the three dimensions of sustainability, e.g. to create an equal and sustainable societies and a circular and bio-based economy</td>
<td>National: 4</td>
</tr>
<tr>
<td></td>
<td>Prop. 2000/01:65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prop. 2013/14:39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fi 2018:3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Knowledge from different academic fields and sectors, e.g. legislators, industry etc.</td>
<td>National: 4</td>
</tr>
<tr>
<td></td>
<td>• The legislation needs to enable fair play rules regarding information access and ability to work for the achievement of the goal in practice</td>
<td>National: 2</td>
</tr>
</tbody>
</table>
6. Discussion

6.1 Analysis of the findings

In this thesis, I studied the key hindering and facilitating governance mechanisms to achieve sustainable chemical management in Sweden from a cross-scale perspective. To answer this question, I investigated policy documents and interviewed key practitioners working with these policies. My research approach combined a Governance Architecture perspective with the scale framework by Cash et al. (2006). Governance Architecture, which is a part of the ESG framework, was used to gain understanding of how the identified mechanisms affects the institutions’ abilities to collaborate and interact for strong sustainable chemical management on a national and municipality level. The purpose of the study was to investigate how the studied policies work in practise. The aim of the study was to develop an analytical framework that contributes to the cross-scale boundary literature and can be of help in the policymaking.

The empirics showed that the hindering mechanisms foremost were caused by a scale gap or a policy gap (see Table 5). Two of the hindering mechanisms were found to be created by more than one type of gap. These were (1) a top-down structure and (2) authority, jurisdiction and hierarchy.

<table>
<thead>
<tr>
<th>Hindering mechanisms</th>
<th>Scale gap</th>
<th>Implementation gap</th>
<th>Policy gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power imbalances</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top-down structure</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Authority, jurisdictional and hierachal limits</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Conflicts of interests</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reductionism</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic dimension of sustainable development</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetric information</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short term-sustainability</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The issue of scale and policy gaps shown in this study can be overcome by basing chemical management on a cross-scale perspective. This requires an integrated approach which involves the components interdisciplinary, legislation and politics. The findings from this study shares similarities with a study conducted by Honkonen & Khan (2017) who identifies policy gaps between chemical policies on a national level which could hinder the achieving a toxin free environment on the national level. To overcome policy gap issues the scholars suggest a comprehensive approach, meaning that the chemical pollution issue integrates into the sustainable development planning, i.e. the Agenda 2030. Their approach has a cross institutional perspective and is unified with what is described as an integrated approach in my study.

An integrated approach could help counteract the hierarchal structures set between the institutions and the asymmetric information, making it possible for the actors along the supply chain to make rational decisions based on the chemical footprint. Asymmetric information is rooted in the literature as the rational choice theory, this is because knowledge steers peoples’ individual preferences which determine how that individual will act (Vervoort et al., 2012). If the time and effort is limited, the individual will accept the information that is likely to help them without a critically evaluation (Oppenheimer, 2012). See Figure 6 for a schematic illustration of the facilitating mechanisms. The figure shows that knowledge and information sharing are key factors affecting whether the chemical management will be limited by the hindering mechanism, or creates synergies increasing the opportunities to achieve sustainable chemical management. Information access and knowledge were identified as important facilitators by Honkonen & Khan (2017) which needs to be based on science. The absence of integrated thinking found in this study were also in line with the analysis by Voulvoulis, Arpon, & Giakoumis (2017) which looks at the EU Water Framework.
Directive. They call for an integrated thinking which bases on participation cross governances, and that the participation needs to be based on interdisciplinarity. The issues of implementing EU policies on lower governmental levels in their study supports my conclusion that interdisciplinarity and an integrated approach are two key facilitating mechanisms in the creation of sustainable chemical management cross institutions, i.e. governances.

The scale dynamic affected by the facilitating and hindering mechanisms identified from my study is presented in Figure 7. Four of the seven scales proposed by Cash et al. (2006) was identified from the empirics, these are the (1) knowledge scale, (2) rule scale, (3) management scale and (4) jurisdictional scale. The three facilitating mechanisms interdisciplinarity, legislation and politics were present within all four of the scales. The interactions between the four scales and the three facilitating mechanisms are explained in the paragraphs below.

The plan and knowledge scales were spoken of as facilitators that could help to overcome the hinders of jurisdiction, authority and hierarchy by basing the decision-making process on: (1) collaboration and cooperation cross scales, (2) sharing knowledge & experiences cross scales, (3) creating a common vision for all involved scales and (5) interdisciplinarity in the joint work. The contextual and universal knowledge within the knowledge scale was identified as a facilitator to change the norms of how the chemical pollution issue is viewed. The general knowledge amongst the institutions needs to be a part of the basic education. The institutions need to understand that the chemical issue is a part of the environmental issue, this requires an increased contextual knowledge. The general knowledge and contextual knowledge can both affect the norm level within the rule scale if the knowledge is high enough. The new norms can in its turn affect the law making and thereby counteract the legislation hindering the institutions creation of a toxin free environment within and cross the institutions. Norms can also affect the strategy work which takes place within the management scale. Examples mentioned by the interviewees were that Sweden have showed the EU that Sweden can live more sustainable without affecting the economy. Such success stories could have an impact on the legislation process. How ambitious these strategies get depends a lot on the engagement of the EU.

The management scale is dependent on the jurisdictional scale because EU affect the strategies for the lower placed institutions. The lower placed institutions could affect the EU-legislation if they can show success stories from their conducted projects. One interviewee from the municipality and two from the national governance institution recognised the importance of success stories. One example was Sweden’s

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**DECISION-MAKING FOR SUSTAINABLE CHEMICAL MANAGEMENT**

<table>
<thead>
<tr>
<th>INTERDISCIPLINARITY</th>
<th>LEGISLATION</th>
<th>POLITICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Knowledge from different fields &amp; sectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Involve practitioners from the institutions involved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Invite academies &amp; the industry to take part in the process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Make it possible to work with the goal in practice, e.g. fair play rules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Are given the authority to work for the achievement of the decision (the goal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• View the chemical issue as part of an environmental issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Base decisions on interdisciplinary knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Make decisions that include theoretical strategies and experiences from the practical work that is included in the strategy</td>
<td></td>
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</tr>
</tbody>
</table>

**Figure 6.** Important components to include in the decision-making process to create sustainable chemical management. Based on seven in-depth interviewees with practitioners working with Sweden’s environmental quality goal A Non-Toxic Environment and/or Agenda 2030.
work to ban Quicksilver, a work that started on a governmental level. Today a global convention for Quicksilver has been developed and are now being implemented. To create sustainable chemical management, the scale dynamic between the knowledge, rule, management and jurisdictional scales are of key importance. How these scales are connected is illustrated in Figure 7. As explained above can the contextual and universal knowledge can affect the norm creation, and the norms can affect the legislation. Strategies can affect the legislation by showing how the current legislation works in practice in different tasks and projects. The current chemical management strategies are to a large extent affected by the EU. The local and national levels can affect the EU’s approach to the strategies in progress.

![Figure 7](image_url)

**Figure 7.** Illustration of cross-scale and cross-level interactions in the chemical pollution management based on how the seven practitioners working with the non-toxin environmental goal and/or Agenda 2030 perceptions of how which premises the chemical management in Sweden can achieve a Non-Toxic Environment in the current system. The scale framework is adapted from Cash *et al.* (2006). The arrows show what levels can push for sustainable development in other levels within one scale or cross-scales.

### 6.2 Reflections on the research approach and future research

The framework applied in this study (see Figure 3) enabled the identifying of the hindering and facilitating mechanisms from a scale dynamics perspective. It was a useful tool to analytically cut the different dimensions, i.e. what was causing the isolation across the institutions in their work for a toxin free environment. This study was not aiming to contribute to a generalizing constructed framework, but to investigate if it could be a useful approach to identify the scale and cross-scale dynamics. The developed framework adds to the operationalisation of the crosscutting theme the scale issue.

It was found in this study that the framework by Cash *et al.* (2006) and Biermann *et al.* (2007) strengthen each other. Cash *et al.* (ibid.) gives a clear categorisation and definition of the seven scales. What is missing in their framework is to include the dimensions and scales within and between the institutions that lays out the system, together with the concept scale dependence. These missing pieces in the framework by Cash *et al.* (ibid.) are integrated in the framework by Biermann *et al.* (2007). The approach taken to
address structural constraints and opportunities, i.e. the hindering and facilitating mechanisms, can be criticised for providing subjective truths. The participants were given open questions in the beginning of the interviews, in the later part of the session I controlled that I had interpreted the mentioned mechanisms correctly. This is a margin of error, I could have had another perception than the one they described to me, but instead of correcting me they accepted my version. If repeating the study, I would have thought of this element when constructing the interview guide. To base the question on the seven scales by Cash et al. (2006) and asking them to talk about how they perceive that the scales are connected might have increased the objectivity. That approach would minimise the risk that the interviewer subconsciously would steer the results.

Documentation analysis generates more objectivity than analysing people’s experiences (Aveyard, 2014; Flick, 2007; Henricson & Billhult, 2017; Marshall & Rossman, 2016). The margin of error is thereby larger in the empirics gathered from the interviewees compared with the policy documents. This is because I as the researcher integrate with the interviewees. The qualitative method originates from the holistic tradition, which states that there is no absolute truth (Marshall & Rossman, 2016). With that ontological standpoint the interviewees represent their truths. Their perspective is not considered as the absolute truth but as a version of the truth based on their experiences. To get a full picture it is therefore important to get as many perspectives as possible, from people that have experiences of the phenomenon for different point of views (Henricson & Billhult, 2017). I was able to interview individuals from different institutions, i.e. municipality, national authority, national government and two persons who worked a national level but had worked with chemical management policies on the EU level. This provided empirics from different perspectives. However, due to the low number of people presenting each institution generalised conclusions cannot be made. The semi-structured approach for the interview guide could be criticised for being too difficult to draw any conclusions from. It might have been more suitable to base the interview guide on specific facilitating and hindering mechanisms and ask how they perceive that these mechanisms are connected. An argument against this criticism is that if presuming certain mechanisms, the answers might not be based on their perspectives. This potential tension between flexibility and structure is an important point which needs to be further investigated.

The developed framework method for cross-scale analysis in this study helped to identify how the institutions are connected, as well as the interaction with the shared principles and practices in the system. Therefore, the study of cross-scale dynamics suggested by Cash et al. (2006) should be incorporated into the ESG framework. A next research step in the operationalisation of the ESG framework could be to explore the practical use of the constructed analytical framework to identify facilitating and hindering mechanisms and the scale dynamics. The analytical framework adopted in this study could have the potential to study scale challenges for governance. It could help to understand how the scales are framed in policy documents and how the scale interaction works in practice; how these scales are dependent on each other; and how the interactions are between scales. To create sustainable chemical management, we need to understand how policies works in practice, by listen to the practitioners was found as a key element to gain this insight.

I focused on one of the crosscutting themes within Governance Architecture, when analysing the findings I understood that the other three themes would enrich the discussion. I chose to focus on only one theme due to time restrictions, I see the benefits of including all four crosscutting themes in the future analysis.

The development of ESG theory should ultimately aim to provide useful frameworks and analysis (Folke, 2006). Future studies of chemical management in the sustainability fields should consider the root of the studied phenomenon. To analyse the phenomenon as a scale, implementation and a policy gap enriches the findings and could help to operationalise Governance Architecture. Moreover, an in-depth study of this field historicizing its origin and including more than three of the identified institutions could bring more use to the ESG theory. Also, from a methodological point of view the circular research approach to qualitative research proposed by Hennink, Hutter & Bailry (2015) would have been interesting to apply. The approach is a living process between the study design, data collecting and data analysis, in line with the Hermeneutic cycle. The empirics is steering the study until the empirics do not add new viewpoints. This is a very interesting approach which I would have tested if I had conducted this study as a PhD thesis.
7. Conclusions

This research contributes to the discussion of how to make chemical management more sustainable. Specifically, this research intended to investigate what is facilitating and hindering the achievement of a sustainable chemical management in Sweden from a cross-scale perspective, and how Governance Architecture could be used to help answer this. Qualitative research was chosen to elaborate on the problem from the viewpoint of the participants. The questions the interviewees were asked to reflect upon related to chemical management and sustainable development. The target group consisted of two groups. One group had experience from working with sustainable chemical management on a municipality level, the other group had experience from working with sustainable chemical management on a national level.

A difference between the two interviewed groups and the analysed documents could not been identified regarding the facilitating and hindering mechanisms affecting the creation of sustainable chemical management. The hindering mechanisms were categorised if they were caused by a gap in scale, implementation or policy. A difference between the two interviewed groups and the analysed documents could not been identified. An interesting difference was in the finding that scale gaps and policy gaps were overrepresented as connected to the identified hindering mechanisms. The study showed that to create sustainable chemical management cross-scale coherence between policies a legislation affection the implementation of the Swedish national goal a Toxin Free Environment is needed. To increase the coherence three elements is needed, these are interdisciplinarity, legislation and politics (see Figure 6).

When linking these findings with sustainable development I see the potential benefit in applying the tested analytical framework in the chemical pollution issue discussion. The framework contributes to the discussion on policymaking for sustainable development, but it should be seen as heuristic. By sharing experiences of how the policies work in practice, understanding can be gained if the hinders to achieving a toxin free environment is a result of missing elements in the policies, missing of tools to implement the policies, or if the lack of integration cross-scale is limiting the work. This discussion, specifically the research question on the usefulness of Governance Architecture, was conducted with the hope of motivating further thinking of how to conceptually formulate a scale framework for sustainable chemical use policies, as well as to the debate about how to achieve a toxin free environment within and across scales. My study does not generate generalisations, but it adds a little piece to the puzzle.
8. Acknowledgements

This work would not have been possible without the practical experience from my internship at Stockholm municipality where I started to ask myself why Sweden will not reach their national goal a *Toxin Free Environment* after working 30 years to achieve the goal. I started to see lack of integration between different institutions and wondered that is creating the scale challenges and how it could be solved. I want to thank Arne Jamtrot and his colleagues at the chemical centre within the municipality for the possibility to experience how they work at a local level to create a toxin free environment.

I am especially indebted to Dr. Tiina Häyhä from Stockholm Resilience Centre, Stockholm University, and Dr. Annette Löf at the Department for Urban and Rural Development at the Swedish University of Agricultural Sciences in Uppsala, for their time and support throughout the thesis process. I am grateful to all of those with whom I have had the pleasure to interview. I am overwhelmed for the support of my family during the thesis, especially for my loving and supportive wife, Emily, for her endless patience. I would also like to thank Oliver Albert Matikainen for his contributing as opponent.
9. References


Publications.


Appendix A. The interview guide

Background information

Anonymity number:

1. In a few sentences, describe your academic and working history that have led you to your current job. (I want to understand what your opinions are built on, perspectives you have worked from earlier)

2. How and in what ways are you working with the goal a Toxin Free Environment and Agenda 2030? (I want to understand in what sense you are working with the goals. For example, if you participated in writing the current Swedish/municipality policies, work with implementing, the following up of the goals and so on)

Theme 1 a Toxin Free Environment

3. What are your experiences from working with a Toxin Free Environment on a national/local level? (You are welcome to give examples from experiences difficulties and success stories)

4. What do you see are the possible hindering and driving factors in your current way of working with the goal A toxin free Sweden/Stockholm?
   a. Based on your experiences, what do you see are missing in the current approach?

Theme 2 Agenda 2030, from a chemical perspective

6. How do you relate to Agenda 2030 in your work with chemicals? (I want to understand how, when, in what way and when the Agenda 2030 in incorporated)

7. What hindering and facilitating factors do you see with working with the two plans together? (You are welcome to give examples from situations, conversations and so on)

Theme 3 A policy which in practice creates a toxin free Sweden/municipality

8. How do you see the relationship between the factors you have mentioned as being driving or hindering? (I want to understand how you see the problem from a systems perspective)

9. What is your vision of a toxin free environment? (I want to understand which type of sustainability you are working for)

10. Show my model
   a. How do you interpret this model?
   b. In your work, do you see that a model like this would be of use? If so in what ways?
c. **How would you have constructed the model different?** (What would you change, to what and why?)

11. Do you have any comments to add to the discussion, or for the research in general?