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Resilience and Adaptivity of EU Pesticides Law

Assessing Theory and Legal Capacity

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PREFACE

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ABSTRACT

The utilisation of pesticides within agriculture may contribute to a transgression of the ecological boundaries of the Earth. However, pesticides play an essential role in sustaining human welfare by providing food security. This thesis aims to explore how this regulatory challenge may be handled, and potential ways of improving EU pesticides law from the perspective of ‘planetary boundaries’. More specifically, this thesis investigates in what ways social-ecological resilience theory can inform EU pesticides law, whether adaptive and resilience capacity are currently reflected within these legal instruments, and how these capacities can be improved.

The methodology of this thesis includes both an ‘internal’ and ‘external’ perspective on the law. Social-ecological resilience theory is an interdisciplinary framework for understanding and addressing the challenges stemming from the interaction of social and ecological dynamics, aiming to make it possible for social-ecological systems to maintain core functions and continue developing. This theory aims to provide tools for handling aspects such as change, pressure, shock, uncertainty, and complexity – which are characteristics significant for the issue of pesticide usage. On the basis of social-ecological resilience theory, adaptive law theory suggests features and functions that are important in a legal context for building resilience of social-ecological systems. The EU legal instruments governing agricultural pesticide usage, Regulation 1107/2009 and Directive 2009/128/EC, are evaluated against a set of adaptive law criteria developed within research for measuring adaptive and resilience capacity of regulatory instruments. The main conclusions of these analyses are that social-ecological resilience theory can provide guidance on how to make EU pesticides law capable of handling regulatory challenges, significant for pesticide usage. It may be a tool for establishing legal structures that enhance an informed balancing of different regulatory aims, and for including features within EU pesticides law that are necessary for building resilience within social-ecological systems – including the ability to avoid transgression of ecological thresholds. Adaptive capacity, contributing to social-ecological resilience, is currently rather well reflected within the legal instruments at issue. Hence, this regulatory package may serve as a reference for the making of laws having adaptive and resilience capacity. Certain features of these instruments however, could be improved. Additional theoretical concepts and tools are also likely to be required to ensure that pesticide usage does not actually contribute to transgression of ‘planetary boundaries’.

Keywords: *pesticides, agriculture, resilience, EU law, adaptive law*

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1. INTRODUCTION OF THE CONTEXT

Pesticide use is standard practice in today's farming. The term 'pesticides' refers to a wide variety of substances and products that are used across the food chain 'from farm to fork'. They are considered vital to guarantee food security, i.e. to protect agricultural production and to secure food supplies. At the same time, pesticides are chemicals that are released into the environment to kill organisms, potentially causing adverse effects on the environment, and human health. This section aims to broadly outline the phenomenon of pesticides – its history, current developments, as well as its commercial aspects. A description of the functions and the potentials of pesticides usage within agriculture follows, before addressing the environmental risks and concerns. Finally, the regulatory approaches to pesticides at international level and EU level are addressed.

1.1. A Brief History of Pesticides

In the early 1900s, the development of agriculture changed from the field to the laboratory. There was an enthusiasm for chemicals and their potential to end food scarcity.¹ By the 1940s, a great transformation of agriculture took off. This science-driven process, which is referred to as the Green Revolution, generated the industrial methods of agriculture that is dominant today. These methods, with frequent utilisation of chemicals, fertilisers, and high-yield crops, have dramatically increased the yield in agricultural production.²

Following the 1940s and the wake of the Green Revolution, the use of pesticides increased immensely.³ However, in the early 1960s, biologist Rachel Carson brought awareness to the environmental risks of pesticides. In her book 'Silent Spring', the dangers of persistent chemicals were exposed – especially how the pesticide DDT (Dichlorodiphenyltrichloroethane) killed non-targets animals by accumulating in the bodies of the predators, moving up the food chain. Evidence of adverse effects of pesticides for both human health and wildlife and public concerns of these effects followed. This led to the introduction of pesticide controls and regulation in both the U.S. and throughout Europe in the early 1970s.⁴ The concerns about pesticides were also essential for the launch of the global environmental movement.⁵ Nevertheless, the use of pesticides did not decline.

¹ Emanuela Bozzini, *Pesticide Policy and Politics in the European Union: Regulatory Assessment, Implementation and Enforcement* (Cham: Springer International Publishing 2017) 3–4.

² Mary Jane Angelo, *The Law and Ecology of Pesticides and Pest Management* (Ashgate 2013) 51–52.

³ Bozzini (n 1) 2.

⁴ *ibid* 4–5.

⁵ *ibid* 14.

In the U.S., it has grown significantly since the 1970s.⁶ Globally, the use of pesticides in agricultural production has increased from 1.5 kg/ha in 1990 to 2.57 kg/ha in 2016. Regarding Europe, the usage has been fairly constant between 1990 and 2016, varying between 1.3 and 1.67 kg/ha, with the highest number registered in 2016.⁷ Considering statistics on the sale of pesticides, the European Commission (the Commission) states that there are no signs of less reliance on pesticides in Europe.⁸

Today, increasing resistance among weeds and pests to well-established pesticides is a main reason for innovation. Biological pesticides, biotechnological pesticides, and nanopesticides are currently emerging as complements to traditional chemicals.⁹ Research on pesticide products receive significant financial resources. Reportedly, over €2 billion was invested in product development in 2014.¹⁰ Looking further into the commercial side of pesticides, rising costs has caused a concentration of the market structure with a few dominant actors. Nevertheless, the sector remains highly profitable according to market analysis.¹¹ By 2022, it is estimated that the global pesticide market will have a value of \$79 billion, compared to \$61 billion in 2017.¹²

1.2. Food Security – the Necessities and Potentials of Pesticides

The main functions of pesticides in agricultural production may be gathered under the concept of food security. This concept is defined as the condition when ‘all people in a country, at all times, have physical and financial access to adequate, safe, and nutritious food that meet their dietary needs and food preferences’.¹³ The potential benefits of pesticides are, inter alia, decreased food losses; elimination of pathogens; as well as reduced labour and energy use.¹⁴ Those sympathetic to the Green Revolution give pesticides credit for the fact that, since the 1800s, starvation has disappeared in many parts of the world (albeit not all).¹⁵ Data from the Food and Agriculture Organization of the

⁶ Angelo (n 2) 85.

⁷ Food and Agriculture Organization of the United Nations (FAO), ‘Food and Agriculture Data’ <www.fao.org/faostat/en/#home> accessed 9 May 2019.

⁸ European Environment Agency, ‘Pesticide Sales’ (29 November 2018) <www.eea.europa.eu/airs/2018/environment-and-health/pesticides-sales> accessed 9 May 2019.

⁹ Bozzini (n 1) 5, 7.

¹⁰ *ibid* 8.

¹¹ *ibid* 7–8.

¹² BBC Research, ‘Biopesticides: Global Markets to 2022’ (July 2018) <www.bccresearch.com/market-research/chemicals/biopesticides-global-markets-report-chm029g.html> accessed 9 May 2019.

¹³ David A Bender, ‘Food Security’, *A Dictionary of Food and Nutrition* (4 edn, Oxford University Press 2014).

¹⁴ Bozzini (n 1) 8, 21.

¹⁵ In 2017, the prevalence of undernourishment among the population was 20.4% in Africa, 11.4% in Asia, 7.0% in Oceania, and 6.1% in Latin America and the Caribbean. In Northern America and Europe, the numbers were below 2.5%. FAO, ‘2018: The State of Food Security and Nutrition in the World’ <www.fao.org/state-of-food-security-nutrition/en/> accessed 9 May 2019.

United Nations (FAO) shows that agricultural production has tripled globally since the 1940s.¹⁶ If the utilisation of chemical pesticides ceased it is estimated that between 25% and 40% of the world food supply could be lost each year, which seriously would jeopardise food security.¹⁷ Moreover, pesticides may reduce the cost of food production, making food affordable to people that currently suffer from starvation.¹⁸

Looking ahead, it is stated that agricultural production has to increase by 75% in the years to come, to sustain the growing human population of the world.¹⁹ In light of this, it is argued that pesticides based on all available technologies must be utilised in order to achieve food security.²⁰ This view is however questioned by a variety of actors, from activists to institutions. The counterarguments read that intensive farming methods with extensive use of pesticides are unsustainable. In the long term there is a risk that it may ruin the natural factors that are necessary for agricultural production, such as fertile soil; clean water; and biodiversity. Furthermore, pests tend to develop resistance to the pesticides that they are exposed to, i.e. the efficiency of pesticides fall the more they are used, causing a need for increased pesticides usage.²¹ It is argued that food security instead should be achieved by methods based on small-scale production; variegated production; and organic methods that do not jeopardise natural resources.²²

1.3. Toxicology and Environmental Concerns

Looking into the development of toxicology (which is the scientific study of poisons and their effects on living organisms) there is no 'linear progression of discoveries leading to an orderly accumulation of evidence'.²³ Instead, the history of the field is characterised by contradictions and contrasts among competing paradigms, described as 'a back and forth of forgetting, remembering, contest and

¹⁶ Bozzini (n 1) 8–9.

¹⁷ *ibid* 9, with reference to Graham Matthews, *Pesticides: Health, Safety and the Environment* (John Wiley & Sons 2016).

¹⁸ *ibid* 9.

¹⁹ *ibid* 9, with references to FAO, 'How to Feed the World in 2050'

<www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf> accessed 9 May 2019.

²⁰ Peter Chapman, 'Is the Regulatory Regime for the Registration of Plant Protection Products in the EU Potentially Compromising Food Security?' (2014) 3(1) *Food and Energy Security* 1.

²¹ HF van Emden and MW Service, *Pest and Vector Control* (Cambridge University Press 2004) 115–116.

²² Bozzini (n 1) 10; United Nations General Assembly (UNGA), 'Report submitted by the Special Rapporteur on the right to food, Olivier De Schutter' (20 December 2010) Human Rights Council, Sixteenth session UN Doc A/HRC/16/49.

²³ Bozzini (n 1) 13.

disagreement'.²⁴ Nevertheless, there is nowadays a general awareness among scientists, regulators, and citizens of the potential harms of pesticides.

With regards to human health concerns, even though the exposure is low pesticides are thought to cause illness to individuals who are exposed to them over a long period of time, such as workers, bystanders, and those living in agricultural areas. Cancer, neurological diseases, chronic asthma, as well as effects on fertility and reproduction, are some of many health issues that may occur.²⁵ From the environmental perspective, pesticides pose a range of risks to individual species, as well as to whole ecological systems. For example, poisoning of non-target animals, such as birds, butterflies and frogs, and beneficial insects, such as bees and other pollinators, has been noticed. Such effects threaten biodiversity, which in turn ultimately puts food production at risk. Moreover, many pesticides have a persistent characteristic, i.e. they do not easily disappear and may cause problems even a long time after application as they spread through ecosystems. This may lead to, *inter alia*, pollution of soil and groundwater.²⁶ Over time, more and more 'unexpected' effects of chemicals have been discovered, followed by controversies surrounding the issue of causality in complex ecosystems.²⁷ One example of this is the issue of neonicotinoids, a class of pesticides that were introduced in the 1980s. They are now pointed out as a possible cause for the decline of honey bee and bumble bee populations, which has been observed in Europe and the U.S. since the early 2000s.²⁸

1.4. Regulatory Approach – International and EU Outlooks

The tension between, on the one hand, achieving food security, and on the other hand, protecting the environment and public health, is at the centre of pesticide policy and politics. This line of conflict is reflected in every regulatory regime on the matter.²⁹ However, at an international level, there is actually a very small number of agreements that concern pesticides and there is no agreement that specifically addresses environmental risks. The international standards that have emerged are mainly related to human health issues of pesticide residues in food. Besides the aim of protecting consumers, these standards have been deemed necessary since varying legal requirements between different countries may be considered illegitimate protection of domestic production, contrary to the

²⁴ David Hecht and others, 'Comments on Davis, "Banned: A History of Pesticides and the Science of Toxicology"' (2015) 5(8) *H-Environment Roundtable Reviews* 1, 14.

²⁵ Bozzini (n 1) 12.

²⁶ *ibid*, with references to André Leu, *The Myths of Safe Pesticides* (Acres 2014) and Jules Pretty (ed), *The Pesticide Detox: Towards a More Sustainable Agriculture* (Earthscan 2005).

²⁷ Bozzini (n 1) 11–13; Martin Enserink and others, 'The Pesticide Paradox' (2013) 341(6147) *Science* 728, 728.

²⁸ Bozzini (n 1) 77–78.

²⁹ *ibid* 2.

rationales of international trade regimes.³⁰ Indeed, pesticide regulation may be a source of bitter political and economic controversies due to its potential effects on international trade.³¹

Within the European Union (the EU), regulatory action on agricultural pesticide usage was taken in the early 1990s. This may be understood against the need to harmonise environmental protection measures in order to not disturb the functioning of the EU internal market. Environmental issues were also gaining increased attention among EU publics and governments.³² Current EU legislation on the matter was adopted in 2009 and establishes rules on both the pre- and post-market phases of pesticide usage.³³ From a global perspective, EU pesticide regulation may be considered as strict. During the last decades, hundreds of chemicals that are normally in use in other parts of the world have been removed from the EU market.³⁴

³⁰ *ibid* 14–15.

³¹ *ibid* 17.

³² Albert Weale and others, *Environmental governance in Europe: An ever closer ecological union?* (Oxford University Press 2000) 491.

³³ Regulation (EC) 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC [2009] OJ L309/1 (hereinafter PPP Reg); Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides [2009] OJ L309/71 (hereinafter SUD).

³⁴ Bozzini (n 1) 19, 21.

2. AIM AND METHOD

Broadly, the aim of this thesis is to explore potential ways of improving EU pesticides law. This will be done from the perspective provided by the concept of ‘planetary boundaries’, which influences the choice of theoretical framework to that of social-ecological resilience. More specifically, the aim is to investigate in what way social-ecological resilience theory can inform EU pesticides law, and whether EU pesticides law currently has the capacity to contribute to the resilience of social-ecological systems. In this section, the relevance of studying the laws of agricultural pesticides usage is addressed, and the choice of theory is explained. The chosen research questions are then presented, before methodological considerations and challenges are discussed. Finally, the practical methods for answering the research questions are described.

2.1. Framing the ‘External’ Issue

This thesis takes its point of departure in an issue ‘external’ to the law, namely the utilisation of pesticides in agricultural production. To put this into context, one may turn to the concept of ‘planetary boundaries’. This concept is a tool to understand and address the pressures that human activity is posing to the Earth. Within this area of research, nine ‘planetary boundaries’ are suggested, which within it is expected that humanity can ‘operate safely’. Transgressing one or more of these boundaries may be ‘deleterious or even catastrophic for human well-being’.³⁵ It is suggested that non-linear and abrupt change on a planetary level could be triggered.³⁶

The large number of chemicals that are commercially used, inter alia in agricultural production, cause countless adverse effects to species and ecosystems. Recently, it was concluded that 40% of the world’s insect species are threatened with extinction and pesticide usage is identified as one of the reasons for this situation.³⁷ It has been concluded that chemical pollution stresses ecosystems and human health to the extent that the ‘safe operating space’ of the ‘planetary boundary’ of chemical pollution is being transgressed.³⁸

One shall however note that properly relating pesticide usage to the concept of ‘planetary boundaries’ is complicated. An activity may pose pressure in relation to several boundaries

³⁵ Johan Rockström and others, ‘Planetary Boundaries: Exploring the Safe Operating Space for Humanity’ (2009) 14(2): 32 *Ecology and Society*.

³⁶ *ibid.*

³⁷ Francisco Sánchez-Bayo and Kris A G Wyckhuys, ‘Worldwide Decline of the Entomofauna: A review of its drivers’ (2019) 232 *Biological Conservation* 8, 8.

³⁸ ML Diamond and others, ‘Exploring the Planetary Boundary for Chemical Pollution’ (2015) 78 *Environ Int* 8, 8.

at the same time. Interactions between pressures, related to different boundaries, may also change the safe level of one or several boundaries.³⁹ For example, chemical pollution may influence the biodiversity boundary by reducing the abundance of species, and potentially increase the vulnerability of species to other pressures, such as climate change.⁴⁰

2.2. The Relevance of Researching EU Pesticides Law

In this thesis, certain measures governing agricultural pesticide usage are studied. Broadly, the aim is to explore potential ways of improving pesticides law. This exploration will be carried out against the perspective provided by the concept of ‘planetary boundaries’. In this perspective, it is acknowledged that there are thresholds within the ecological systems that should not be transgressed, if not to jeopardise the prerequisites for human well-being.⁴¹ The utilisation of pesticides may be, or perhaps already is, contributing to a transgression of the ecological boundaries of the Earth. At the same time, pesticides play an essential role in providing human welfare by sustaining food security for the current as well as the future human population.⁴² Thus, pesticides usage in agricultural production is a multifaceted, challenging, and urgent issue. In light of this, the call for greater attention on the governance of this activity is imminent.

Governance may be described as ‘the sum of many ways that individuals and institutions, public and private, manage their common affairs’.⁴³ It often includes strategies, structures, institutions, and actions that are meant to respond to different problems, such as environmental problems. Laws and legal instruments have an essential role in governance systems. They may serve as a basis for the system, or as a tool within it.⁴⁴ Since the ‘planetary boundary’ of chemical pollution is being transgressed, research suggests that current pollution control measures, both at a local and global level, are insufficient.⁴⁵ Consequently, it seems both relevant and urgent to pay attention to the laws governing agricultural pesticide usage, and explore potential ways for how these can be improved.

³⁹ Rockström and others (n 35).

⁴⁰ *ibid*, with references to Bjørn Munro Jensen, ‘Endocrine-disrupting chemicals and climate change: a worst-case combination for arctic marine mammals and seabirds?’ (2005) 114(Suppl 1) *Environmental Health Perspectives* 76; Pamela D Noyes and others, ‘The toxicology of climate change: environmental contaminants in a warming world’ (2009) 35(6) *Environ Int* 971.

⁴¹ See above section 2.1.

⁴² See above section 2.1.

⁴³ The Commission on Global Governance, *Our Global Neighbourhood: The Report of the Commission on Global Governance* (Oxford University Press 1995) 2.

⁴⁴ Brita Bohman, *Transboundary Law for Social-Ecological Resilience? A Study on Eutrophication in the Baltic Sea Area* (Department of Law, Stockholm University 2017) 30.

⁴⁵ Diamond and others (n 38) 8.

More specifically, this thesis sets out to explore how the EU law regulating this matter can be improved. The EU agricultural sector is one of the most productive in a global perspective, characterised as a ‘green giant’. It is highly integrated in the world agricultural market, with both import and export of agricultural and food products.⁴⁶ In order to gain access to the EU internal market, non-EU agricultural producers often have to adapt to EU standards.⁴⁷ Consequently, even though the EU is only one regional regulatory context, the EU law governing these issues potentially has an influence on agricultural production and environmental protection also beyond the Union. With this in mind, EU pesticides law seems highly relevant in relation to the ‘external’ issue of pesticide usage and the risk of transgressing ‘planetary boundaries’.

2.3. The Choice of Theory: Social-Ecological Resilience

The theory that has been chosen for this study is social-ecological resilience. This theory constitutes, inter alia, a theoretical framework for research on environmental governance providing an interdisciplinary perspective.⁴⁸ Since law is an essential part of governance systems, social-ecological resilience theory appears potentially relevant also to legal research. As a theoretical framework, social-ecological resilience is aimed to be a tool for ensuring human well-being in the face of the rapid changes; the complexity; and the inherent uncertainties, all of which are perceived to characterise the world of today.⁴⁹ These characteristics are significant also for issues related to agricultural pesticide usage.⁵⁰ However, the law often struggles to deal with these characteristics.⁵¹

There is a growing interest for social-ecological resilience theory among legal scholars. Despite this, the relationship between social-ecological resilience and the law is rather ‘under-explored’,⁵² which calls for further investigations. However, one of the suggestions within law and resilience research is that, in the light social-ecological resilience theory, the law should be adaptive.

⁴⁶ Bozzini (n 1) 18.

⁴⁷ *ibid.*

⁴⁸ Social-ecological resilience theory is presented and addressed in detail below in section 3.

⁴⁹ Reinette Biggs, Maja Schlüter and Michael L. Schoon, ‘An Introduction to the Resilience Approach and Principles to Sustain Ecosystem Services in Social-Ecological Systems’ in Reinette Biggs, Maja Schlüter and Michael L. Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 1, 5, with references to Brian Walker and David Salt, *Resilience Thinking: Sustaining Ecosystems and People in a Changing World* (Island Press 2006); Carl Folke and others, ‘Resilience Thinking: Integrating Resilience, Adaptability and Transformability’ (2010) 15(4): 20 *Ecology and Society*.

⁵⁰ See above section 1.

⁵¹ Bohman (n 44) 26; Staffan Westerlund, *Fundamentals of Environmental Law Methodology* (Uppsala University, Department of Law 2007) 156ff.

⁵² Bohman (n 44) 26, 27; Tracy-Lynn Humby, ‘Law and Resilience: Mapping the Literature’ (2014) 4 *Seattle J Envtl L* 85, 101.

Adaptive law theory comes with propositions on, *inter alia*, how the law ought to be in order to contribute to social-ecological resilience. Within research, fairly distinctive criteria for measuring the adaptive capacity of the law has been suggested.⁵³ Therefore, adaptive law theory has been chosen as the specific framework for this analysis of EU pesticides law.

Looking into the specific field at issue, EU pesticides law has, besides the aim of protecting the environment and human health, also the aim of improving the functioning of the internal market as well as improving competitiveness of the EU agricultural sector.⁵⁴ Consequently, different rationales are blended into the same regulatory regime. This may be further understood against the broader context that the EU constitutes. The EU aims to promote economic and social progress, mainly by the means of the internal market, and at the same time protect the environment.⁵⁵ Social-ecological resilience theory comes with a systemic perspective, addressing the broadness and complexity of social-ecological systems. This theory does not solely promote environmental protection, but rather provides analytical tools for how to balance the behaviour of social systems, including markets, with the behaviour of ecological systems.⁵⁶ Considering the multi-purposed character of EU pesticides law, the choice of social-ecological resilience for this study thus seems appropriate. Moreover, the character of this regulatory field, where the rationale of the market meets other rationales, is generally pertinent for the EU. Hence, this exploration may be of interest in relation to other EU regulatory fields. Light may be shed on how social-ecological resilience theory could be employed in relation to regulatory fields that have broader aims than solely environmental protection. Possibly, this could further the relevance of social-ecological resilience as a theoretical framework.

Looking into previous research, no research linking social-ecological resilience theory with EU pesticides law is found, when searching the database Web of Science and the search engine Supersearch (Gothenburg University Library). In a review of the 'law and resilience literature' dated 2014, only 3 out of 74 reviewed items concerned the field of agriculture, and only 6 concerned the jurisdictional context of the EU.⁵⁷

⁵³ See below section 4.3.

⁵⁴ Regulation (EC) 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC [2009] OJ L309/1, art 1.3 and recital 8; Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides [2009] OJ L309/71, art 1.

⁵⁵ Consolidated Version of the Treaty on European Union [2012] OJ C326/13, preamble.

⁵⁶ See below section 3.3.

⁵⁷ Humby (n 52) 100.

2.4. Defining the Research Questions

In a legal context, social-ecological resilience theory has normative consequences, i.e. it suggests what the law ought to be.⁵⁸ Linking this theory with the law may have the effect that certain values and ideals are promoted. However, the aim of this thesis is not to determine what the law ought to be, but to explore ways in which the law may be improved. Hence, the first research question will not investigate whether social-ecological resilience theory should guide EU pesticides law. Instead, it will investigate the potential function of social-ecological resilience as a theoretical framework guiding this regulatory field. Hence, the first chosen research question is:

- In what aspects can social-ecological resilience theory inform the making of EU pesticides law?

The subsequent aim is to examine current EU pesticides law and the extent of its capacity to contribute to the resilience of social-ecological systems from the specific perspective of adaptive law theory. This includes investigating if this capacity could be improved, and if so, in what aspects.

Thus, the second and third chosen research questions are:

- Is adaptive capacity, contributing to social-ecological resilience, reflected in EU pesticides law? If so, how is this reflected?
- Can adaptive capacity of EU pesticides law, contributing to social-ecological resilience, be increased? If so, in what aspects?

Considering the potential of social-ecological resilience theory to inform governance measures for sustained human well-being, these specific research questions seem appropriate for achieving the broader aim of this thesis. Despite the attempt to soften the normative implications of the chosen theory, one may note that these research questions may still, to some extent, have normative effects. Indeed, legal scholarship may generally be considered normative, since saying something about that law includes saying something about world. Developing and furthering theories is not done without certain notions of how the world is and how it may be changed.⁵⁹ This motivates transparency in what perspective informs the choice of theory and research object, namely that provided by the ‘planetary boundaries’.

⁵⁸ See below section 3.

⁵⁹ Claes Sandgren, ‘Vad är rättsvetenskap?’ in Peter Wahlgren and Cecilia Magnusson Sjöberg (eds), *Festskrift till Peter Seipel* (Norstedts juridik 2006) 549–550 (in Swedish).

2.5. Limitations

The given frame requires certain limitations of the scope of this thesis. Since the focus is on the phenomenon of pesticide usage in agricultural production, the substantial scope of this thesis will be the regulation of pesticides used for plant protection. Consequently, the research object will be Regulation 1107/2009 on the ‘Placing on the Market of Plant Protection Products’ (PPPs) (hereinafter the PPP Regulation) and Directive 2009/128/EC on the ‘Sustainable Use of Pesticides’ (hereinafter the SUD).⁶⁰ Regulation No 528/2012 concerning biocidal products,⁶¹ will be excluded from the scope of this thesis. Biocides are pesticides used to control unwanted organisms that are harmful to human or animal health, or cause damage to human activities. They are used as disinfectants, preservatives, or for pest-control in non-agricultural sectors.⁶² Other Regulations that are of relevance in regards to issues related to pesticides, but not directly related to the activity of pesticide application within agricultural production, and hence excluded from the scope of this thesis are Regulation 396/2005 on ‘maximum residue levels of pesticides in or on food and feed of plant and animal origin’ and Regulation 1185/2009 ‘concerning the statistics on pesticides’.⁶³

2.6. Methodological Considerations – ‘Internal’ and ‘External’ Law Methodology

Constructivism is the underlying ontological rationale, i.e. the way of looking at social reality and making sense of it, that guides this thesis. By this, it is supposed that the law is socially constructed, and that it consequently can be developed and re-constructed.⁶⁴ This assumption – the law is not an isolated system, separated from its social context – justifies the employment of a legal methodology that incorporates an ‘external’ perspective. To contrast, an ‘internal’ perspective aims to achieve knowledge by just going into the law itself. An ‘external’ perspective, on the other hand, looks at the law from the outside, how the law is constructed, and how it may influence e.g. social behaviour, economy, or ecosystems.⁶⁵ An ‘external’ law methodology inevitable requires knowledge from outside of the legal system. In other words, it requires an interdisciplinary approach. This may be defined as

⁶⁰ PPP Reg; SUD.

⁶¹ Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products [2012] OJ L167/1.

⁶² Bozzini (n 1) 52.

⁶³ Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC [2005] OJ L70/1; Regulation (EC) No 1185/2009 of the European Parliament and of the Council of 25 November 2009 concerning statistics on pesticides [2009] OJ L324/1.

⁶⁴ Westerlund (n 51) 527.

⁶⁵ *ibid* 511.

a mode of research (...) that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.⁶⁶

Scientific insights in other disciplines (described above in section 2.1) stresses the need of such an ‘external’ and interdisciplinary approach. The ‘external’ problem, i.e. the pressure human activity has come to pose to ecological systems, challenges the legal sciences to be open to other disciplines, both natural and social sciences, and to incorporate the knowledge from these. Otherwise, it will be difficult for the law to address and meet these challenges that go beyond the direct legal system.⁶⁷ Indeed, it is even argued that an ‘external’ law methodology is necessary when developing the law in order to ‘avoid mankind’s ecological crash’.⁶⁸

However, in order to gain knowledge about the law and its ‘external’ dimension, the law also needs to be analysed from an ‘internal’ perspective. This means studying legal sources and investigating how the law should be applied. Thus, both ‘external’ and ‘internal’ perspectives will be employed in this study, even though there will be a focus on the ‘external’ perspective.

2.7. Challenges of Interdisciplinarity

Employing an interdisciplinary methodology however comes with difficulties. Introducing knowledge and theories from other disciplines to the field of law is ‘not just acquired by reading a couple of science textbooks’.⁶⁹ For example, a lack of a shared language and culture between disciplines may cause intellectual misunderstandings, rather than intellectual breakthroughs.⁷⁰ This risk could occur, inter alia, when transferring governance theories from non-legal disciplines, such as social-ecological resilience, into the field of law.⁷¹ Besides the risk of misunderstandings when transferring theories across disciplines, there is a challenge in making non-legal theories and concepts

⁶⁶ National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, *Facilitating Interdisciplinary Research* (The National Academies Press 2005) 2.

⁶⁷ Bohman (n 44) 59–60.

⁶⁸ Westerlund (n 51) 524.

⁶⁹ Elizabeth Fisher and others, ‘Maturity and Methodology: Starting a Debate about Environmental Law Scholarship’ (2009) 21(2) *Journal of Environmental Law* 213, 248.

⁷⁰ Dave Owen and Caroline Noblet, ‘Interdisciplinary Research and Environmental Law’ (2014) 41(4) *Ecology Law Quarterly* 887, 895.

⁷¹ Fisher and others (n 69) 233.

‘operational’ in legal research.⁷² In other words, how can these be made useful for inquiries of the law?

With regards to the resilience perspective, it has mostly been applied within the natural sciences due to its origin in the field of ecology. Thus, it is not self-given how to apply social-ecological resilience theory within legal research.⁷³ Resilience of social systems, which laws and legal structures are part of, may mean something different and depend on very different factors than resilience of ecological systems.⁷⁴ Moreover, approaching the challenges identified within research on social-ecological resilience from the specific perspective of the legal scholar may mean approaching these challenges with certain notions and perceptions, e.g. regarding the understanding of terms and concepts. This should arguably be kept in mind when considering the results of this analysis, as well as other legal analysis, which employ an interdisciplinary theory. In order to handle these challenges within the limited frame for this thesis, the research framework will be largely built upon previous legal studies that have incorporated social-ecological resilience theory. Even though the interest for this theory is fairly new within the legal sciences, a few scholars have shown interest. They have proposed frameworks and principles on how to employ this theory, i.e. showed how it may be transferred into and made operational in the field of law.⁷⁵ By turning to these syntheses of insights and propositions of what social-ecological resilience may mean for the law, the gathered knowledge of the legal scholars engaging in this research will be utilised. This will contribute to the formation of a stable ground for the study and reduce the risk of ‘intellectual misunderstandings’.

2.8. Method – Performing the Research

The first question of this thesis is answered by reviewing the literature that addresses social-ecological resilience theory, both from a general point of view as well as from the specific context of the law. This literature is mostly gathered through searches in search engines, mainly Supersearch (Gothenburg University Library) and Google Scholar, combing relevant search terms. Literature is also identified through the references of certain extensive works on the theory, which point out further literature of relevance.⁷⁶

⁷² Bohman (n 44) 28–29.

⁷³ *ibid.*

⁷⁴ Bohman (n 44) 43.

⁷⁵ *Inter alia, ibid*; Niko Soinen and Froukje Maria Platjouw, ‘Resilience and Adaptive Capacity of Aquatic Environmental Law in the EU: An Evaluation and Comparison of the WFD, MSFD, and MSPD’ in David Langlet and Rosemary Rayfuse (eds), *The Ecosystem Approach in Ocean Planning and Governance* (Brill 2018).

⁷⁶ These works are, *inter alia*, Humby (n 51); Reinette Biggs, Maja Schluter and Michael L. Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social–Ecological Systems* (Cambridge University Press 2015); Shelley Ross

With regards to the second and third research questions, a methodology based on both an ‘external’ and ‘internal’ perspective is employed. The ‘external’ perspective is built on principles, derived from social-ecological resilience theory, which specify features and functions for building resilience. More specifically, it employs certain criteria for evaluating resilience and adaptive capacity of environmental regulatory instruments, identified on the basis of adaptive law and resilience literature.⁷⁷ To properly evaluate EU pesticides law against these criteria, a method with an ‘internal’ perspective is required, in order to say what the law is. Within the EU legal order, there are both certain legal sources and certain methods for legal interpretation. Interpretation is required in order to gain an understanding of the law. This may be defined as ‘the creation of legal meaning according to a judicial methodology’.⁷⁸ Three ‘classical’ methods of interpretation are prominent within the EU legal order – literal, systematic, and teleological methods.⁷⁹ The interpretation of the law at hand will take its point of departure from a literal interpretation, i.e. by looking at the written text of legal provisions and finding meaning through the usual (contemporary) meaning of the words.⁸⁰ The legal acts that constitute the research object are published in the many official languages of the EU. However, the language version that will be used for this investigation is exclusively the English version. Besides literal interpretation, systematic and teleological interpretations will also be employed, especially if the wording is not clear and precise.⁸¹ By a systematic interpretation, the meaning of a legal provision is constructed by considering the functional relationship between the provision at issue, and the normative system to which it belongs, i.e. its place within the wider EU legal order. By this method, a provision cannot be interpreted in a way that creates a conflict between the specific provision and the context of which it is part.⁸² This largely contextual perspective often goes hand in hand with teleological interpretation, which creates the meaning of a provision by searching for the purpose, spirit, or useful effect of it.⁸³ For an appropriate interpretation of EU law, these three methods should not be considered or applied in isolation, but they should ‘operate in a mutually reinforcing manner’.⁸⁴

Saxer and Jonathan D. Rosenbloom, *Social-Ecological Resilience and Sustainability* (Wolters Kluwer 2018); Bohman (n 44); Soininen and Platjouw (n 75).

⁷⁷ Soininen and Platjouw (n 75) 30.

⁷⁸ Robert Schütze, *European Union Law* (Cambridge University Press 2015) 206.

⁷⁹ Lenaerts Koen and A. Gutiérrez-Fons José, ‘To Say What the Law of the EU Is: Methods of Interpretation and the European Court of Justice’ (2014) 20 *Columbia Journal of European Law* 3, 3.

⁸⁰ *ibid* 8.

⁸¹ *ibid* 59.

⁸² *ibid* 16–17.

⁸³ Schütze (n 78) 207.

⁸⁴ Koen and José (n 79) 61.

The sources of EU law are usually divided into two categories, primary and secondary sources. The former refers to the Treaties and the Charter of Fundamental Rights, while the latter refers to sources adopted on the basis of the primary sources, such as Regulations and Directives.⁸⁵ Features that influence the resilience and adaptive capacity of the research object, the PPP Regulation and the SUD, may be found in the wider legal structures of the EU, such as the Treaties. Considering the chosen research questions, the research object will be expanded to also include these wider structures of the EU legal order, if it is relevant for the evaluation of the PPP Regulation and the SUD. The legal sources may also be expanded beyond the primary research object in the employment of systematic and teleological methods of interpretation. This may, inter alia, mean taking Treaty provisions into account, since they constitute the legal bases upon which Regulations and Directives are adopted.⁸⁶ Other sources that may be used as interpretative aids include the recitals of Regulations and Directives, in which the reasons for adopting an act are stated. These reasons are used by the Court of Justice of the European Union (the CJEU) in the interpretation of legal provisions.⁸⁷ The general objectives pursued by the Treaties may also be taken into consideration.⁸⁸ As concerns preparatory works, their importance for constructing legal meaning are stated to be increasing, especially in regards of highly technical EU secondary law.⁸⁹ Also guidelines may serve as interpretative help.⁹⁰ Thus, even though preparatory works and guidelines are not legally binding, they may to some extent serve as aids in the creation of legal meaning. Finally, considering that the CJEU has been granted the competence to interpret the law of the EU,⁹¹ case law may serve as authoritative guidance on how to interpret specific legal provisions.

Practically, literature that summarises and synthesises the content of these sources will be utilised. This literature is found mostly through Supersearch (Gothenburg University Library) and Google Scholar, combing relevant search terms. As regards the formality of referencing, it follows the style of OSCOLA (The Oxford University Standard for the Citation of Legal Authorities). It provides detailed guidance on how to cite a wide range of sources, thus ensuring clear and consistent referencing.⁹²

⁸⁵ David Langlet and Said Mahmoudi, *EU Environmental Law and Policy* (Oxford University Press 2016) 15.

⁸⁶ Koen and José (n 79) 32.

⁸⁷ Langlet and Mahmoudi (n 85) 17.

⁸⁸ Koen and José (n 79) 32.

⁸⁹ *ibid* 59–60.

⁹⁰ Paul Craig and Gráinne De Búrca, *EU Law: Text, Cases, and Materials* (6 edn, Oxford University Press 2015) 109.

⁹¹ Consolidated Version of the Treaty on the Functioning of the European Union [2012] OJ C326/47 (hereinafter: TFEU), art 267.

⁹² Faculty of Law, University of Oxford, 'OSCOLA: The Oxford University Standard for Citation of Legal Authorities' <www.law.ox.ac.uk/research-subject-groups/publications/oscola> accessed 9 May 2019.

3. THEORY

Social-ecological resilience theory intends to understand and address the challenges stemming from the interaction of social and ecological dynamics. This theory aims to be a tool for handling change, pressure, and uncertainty within social-ecological systems, enabling these systems to continue developing. Embracing knowledge from many different disciplines, social-ecological resilience theory includes various perspectives, aspects, and sub-concepts. This theory may thus be challenging to grasp and pinpoint. Nevertheless, this section aims to provide an overview of social-ecological resilience theory, especially those aspects that may be of relevance for researching EU pesticides law. Fundamental assumptions informing this theory will be presented, followed by a description of the theory's potential functions. To put social-ecological resilience theory into a broader context, it will be related to the concept of sustainability. Finally, it will be critiqued and linked to the field of law.

3.1. Viewing the World as Social-Ecological Systems

Social-ecological resilience theory comes with a fundamental assumption on the relationship between humans and nature. Within this theory, human society is viewed as part of the biosphere.⁹³ This means that humanity and nature are intertwined and interdependent. Human action shapes ecological dynamics, from local to global scales, while at the same time, humans rely on nature for well-being.⁹⁴ A concrete example of this is that farming affect and shape ecosystems, habitats, and landscapes both locally and globally. At the same time, the ability to produce food is dependent on ecosystem services⁹⁵, such as pollination and storage and cycling of water nutrients and carbon.⁹⁶ The notion of human society as an inherent part of the biosphere makes the world a social-ecological system.⁹⁷ This concept was introduced in 1998 by Fikret Berkes and Carl Folke in order to emphasise that the

⁹³ The biosphere is a term that refers to the surface part of the Earth in which living organisms exist and interact – the sum of all ecosystems. Chris Park and Michael Allaby, 'Biosphere (Ecosphere)', *A Dictionary of Environment and Conservation* (3 edn, 2017).

⁹⁴ Biggs, Schlüter and Schoon (n 49) 8, with references to Carl Folke, 'Resilience: The Emergence of a Perspective for Social–Ecological Systems Analyses' (2006) 16 *Global Environmental Change* 253; Carl Folke and others, 'Reconnecting to the Biosphere' (2011) 40(7) *AMBIO* 719.

⁹⁵ Generally, the concept of ecosystem services can be defined as 'the direct and indirect contributions of ecosystems, in interaction with contributions from human society, to human well-being'. Leon C Braat, 'Ecosystem Services', *Oxford Research Encyclopedia of Environmental Science* (Oxford University Press 2016).

⁹⁶ Mary Jane Angelo and Joanna Reilly-Brown, 'Whole-System Agricultural Certification: Using Lessons Learned from Leed to Build A Resilient Agricultural System to Adapt to Climate Change' (2014) 85 *U Colo L Rev* 689, 719–721.

⁹⁷ Biggs, Schlüter and Schoon (n 49) 1.

separation of social and ecological systems is ‘artificial and arbitrary’.⁹⁸ A ‘system’ may be described as a group of different parts that are interacting, or acting independently, but nevertheless are interconnected, forming a more complex whole. Systems can be natural, such as ecosystems, or man-made, such as monetary systems.⁹⁹ The joining of natural systems, e.g. an area of land, with social systems, e.g. agriculture, may be defined as a social-ecological system. To clarify, the interactions between humanity and nature are not seen as social plus ecological systems, but as cohesive social-ecological systems.¹⁰⁰

This emphasis of human society as part of the biosphere is relevant, considering the historical notion of the relationship between humans and nature. As a consequence of the Enlightenment, there was for a long time a general view of humans as supreme over nature. Science, technology, and reason are in this perspective viewed as tools only to help in the taming and manipulating of nature, and to overcome natural barriers to exploitation.¹⁰¹ The intensive methods of today’s agriculture, with its extensive use of pesticides, are an outflow of the Green Revolution.¹⁰² That transformation, and consequently the methods of contemporary farming, may be understood against the historical notion of humans as supreme over nature.

Research suggests that social-ecological systems are characterised by strong interactions and feedbacks between social and ecological dynamics, which determine the overall dynamics of the systems.¹⁰³ In social-ecological systems, change is perceived to take place along and across various scales, such as spatial and temporal scales, as well as within and across different domains. For example, global warming, which is a global phenomenon caused by local activities, may change the occurrence and distribution of pests, which in turn may lead to increased use of pesticides at a local level.¹⁰⁴ Another example is that consumer preferences, social norms, or policies at different levels, e.g. in regards of organic farming, may have an impact on pesticide usage in agricultural production, which in turn could have an effect on biodiversity and ecosystem services.¹⁰⁵ Change may be slow, such as degradation of ecosystem services due to agricultural intensification, or change

⁹⁸ Carl Folke and others, ‘Adaptive Governance of Social-Ecological Systems’ (2005) 30 *Annu Rev Env Resour* 441, 443, with reference to Fikret Berkes, Carl Folke and Johan Colding, *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (Cambridge University Press 1998).

⁹⁹ Saxer and Rosenbloom (n 76) 3.

¹⁰⁰ Biggs, Schlüter and Schoon (n 49) 8, with reference to Folke and others (n 49).

¹⁰¹ Saxer and Rosenbloom (n 76) 71–72.

¹⁰² See above section 1.1.

¹⁰³ Biggs, Schlüter and Schoon (n 49) 8, with reference to Folke and others (n 49); Folke and others (n 98) 443.

¹⁰⁴ Rockström and others (n 35).

¹⁰⁵ Biggs, Schlüter and Schoon (n 49) 11–12, with references to Eric F Lambin, Helmut J Geist and Erika Lepers, ‘Dynamics of Land-Use and Land-Cover Change in Tropical Regions’ (2003) 28 (1) *Annu Rev Env Resour* 205, and Fikret Berkes and others, ‘Globalization, Roving Bandits, and Marine Resources’ (2006) 311(5767) *Science* 1557.

may be fast, such as introduction of new regulation in the wake of a crisis (a historical example is the mad cow disease).¹⁰⁶ Thus, processes at different scales interact and generate feedback that leads to unexpected outcomes, making it difficult to predict behaviour and effects. This leads to another fundamental assumption of social-ecological resilience theory, in regards of the character of social-ecological systems, namely that they behave as complex adaptive systems. In short, this means that

- 1) they have the capacity to self-organise and adapt, based on past experience,
- 2) they are characterised by emergent and non-linear behaviour, and
- 3) they have an inherent uncertainty.¹⁰⁷

This assumption, that the world is characterised by rapid social, technological, and ecological changes that are not linear or foreseeable but includes irregular responses, surprises, and cascading effects,¹⁰⁸ have implications for the understanding and governing of social-ecological systems. Inevitably, it calls for governance that is able to deal with profound uncertainty.¹⁰⁹ The vast complexity of social-ecological systems calls for analytical frameworks that are interdisciplinary, and that goes beyond linear and reductionist perspectives, which previously have been common.¹¹⁰

3.2. The Concept of Resilience

There is no single definition or understanding of resilience. Instead, its meaning and function varies depending on the situation.¹¹¹ In the context of a social-ecological system, it has been described as a new way of understanding the creation, and remediation, of challenges arising in such a system.¹¹² In short, it aims to inform and handle the complex challenges arising from the interaction of social and ecological dynamics.

The term resilience has its roots in the discipline of ecology, introduced by C.S. Holing in the early 1970s. He had discovered that ecosystems can ‘flip’ between different stable states, that ecosystem are complex and adaptive, and inherently unpredictable. Holing used the term resilience to refer to the capacity of a system to stay within a stable state, i.e. the amount of disturbance a system

¹⁰⁶ Ika Darnhofer, John Fairweather and Henrik Moller, ‘Assessing a Farm’s Sustainability: Insights from Resilience Thinking’ (2010) 8(3) *International Journal of Agricultural Sustainability* 186, 187.

¹⁰⁷ Biggs, Schlüter and Schoon (n 49) 1.

¹⁰⁸ Bohman (n 44) 26.

¹⁰⁹ Biggs, Schlüter and Schoon (n 49) 12.

¹¹⁰ *ibid* 10, with reference to Simon Levin and others, ‘Social-ecological systems as complex adaptive systems: modeling and policy implications’ (2013) 18(2) *Environment and Development Economics* 111.

¹¹¹ Saxer and Rosenbloom (n 76) 8; Bohman (n 44) 26.

¹¹² Saxer and Rosenbloom (n 76) 3.

can endure before its controls shift to another stable state.¹¹³ Thus, a system's resilience may be measured in terms of distance from thresholds. If these thresholds are passed, the system will be pushed into a new regime.¹¹⁴ These insights contrasted with the dominating view at that time, namely that ecosystems moved around one single stable state. That view implied a fixed carrying capacity of ecosystems, which generated a management mindset of 'optimisation' of the ecosystems to produce maximum of, inter alia, food.¹¹⁵ From the mid 1970s to the 1990s, the resilience perspective spread from the natural sciences and became influential in the social sciences. Research was carried out on social and natural systems, and their relationship, leading up to the invention of the concept of social-ecological systems.¹¹⁶ Nowadays, resilience has become, inter alia, an approach and a type of science that aims to ensure human wellbeing in the face of the complexity, changes, and inherent uncertainties that characterise social-ecological systems.¹¹⁷

In relation to social-ecological systems, the concept of resilience may have two functions that shall be distinguished.¹¹⁸ Firstly, it may be a property of a system, i.e. it may serve to describe a system characteristic. This characteristic has been defined in variety of ways. The most popular definition, based on Holing's use of the term, reads 'the capacity of a system to absorb disturbance and still retain its basic structure and function'.¹¹⁹ Secondly, the concept of resilience is an approach, with a set of certain assumptions, for addressing the tension between persistence and change in social-ecological systems. This means that it serves as a tool for analysing, understanding, and managing the capacity of these systems to handle pressures and absorb shocks, and subsequently maintain their core functions. As part of this, it is also a tool to maintain capacity of renewal, reorganisation and development of social-ecological systems.¹²⁰ It is thus an analytical framework to address and handle the continuous changes and uncertainties that characterise social-ecological systems. It may provide practical guidance for decision-makers, as well as practitioners, on the challenges inherent in these systems.¹²¹

Regarding the function of resilience as an analytical framework, one should note that the resilience perspective has been refined to include the ability of a system to adapt and transform, in addition to the ability endure pressures. These three aspects interrelate across multiple scales.

¹¹³ Folke (n 94) 254.

¹¹⁴ Walker and Salt (n 49) 63.

¹¹⁵ Humby (n 52) 89–90.

¹¹⁶ Humby (n 52) 91.

¹¹⁷ Biggs, Schlüter and Schoon (n 49) 5, with references to Walker and Salt (n 49), and Folke and others (n 49).

¹¹⁸ Biggs, Schlüter and Schoon (n 49) 13.

¹¹⁹ Humby (n 52) 90, with reference to Walker and Salt (n 49) iii.

¹²⁰ Biggs, Schlüter and Schoon (n 49) 10, with reference to Folke (n 94).

¹²¹ Biggs, Schlüter and Schoon (n 49) 1.

Adaptability is part of the resilience perspective, representing the capacity to respond to changing external drivers, as well as internal processes, allowing for development and change along the current stable state.¹²² In an agricultural context, this could e.g. mean replacing pest management strategies based on intensive chemical input with crop rotation, in order to preserve biodiversity and ecosystem services. Transformability is also part of the resilience concept, referring to the capacity to cross thresholds and enter into a new stable state.¹²³ In an agricultural context, this could mean, e.g., to diversify into new activities that were previously not considered to be in the farmers dominion, such as tourism or energy production.¹²⁴ Intuitively, transformability may seem contrary to the basic understanding of resilience. However, from a resilience perspective, changes, crises, shocks, and disturbances are not necessarily viewed as something negative that should be avoided at every price. Instead, it is accepted as an inherent feature of social-ecological systems, which constitute opportunities for change, renewal, and reorganisation.¹²⁵ For example, transformation at smaller scales is perceived to enable resilience at larger scales, e.g. by making use of crises at smaller scales as an opportunity for novelty and innovation, combining experience and knowledge to navigate transitions.¹²⁶ Consequently, analysing social-ecological systems can be carried out along these three inter-dependent dimensions.¹²⁷ Together with the identity or the state of the system at issue, i.e. the variables that constitute the system, these dimensions are all considered essential for understanding the resilience perspective.¹²⁸

3.3. Social-Ecological Resilience Related to Sustainability

In order to clarify the concept of resilience, it may be of value to relate and contrast it with the sustainability concept. Sustainability may be understood as a perspective for integrating, or balancing, environmental protection, economic development, and social justice.¹²⁹ The resilience perspective is considered part of the broader field of sustainability science, since sustainability may include knowing if, and where, thresholds exists within a system, and having the capacity to manage the system to stay

¹²² Biggs, Schlüter and Schoon (n 49) 9, with references to Folke (n 94), and Levin and others (n 110).

¹²³ *ibid.*

¹²⁴ Darnhofer, Fairweather and Moller (n 106) 192.

¹²⁵ Biggs, Schlüter and Schoon (n 49) 9, with references to Folke (n 94), and Levin and others (n 110).

¹²⁶ Folke and others (n 49).

¹²⁷ Humby (n 52) 94, with reference to Steve Carpenter and others, 'From Metaphor to Measurement: Resilience of What to What?' (2001) 4(8) *Ecosystems* 765.

¹²⁸ Humby (n 52) 104–105, with reference to Richard A Barnes, 'The Capacity of Property Rights to Accommodate Social-Ecological Resilience' (2013) 18(1): 6 *Ecology and Society*.

¹²⁹ Saxer and Rosenbloom (n 76) 27, with reference to John C Dernbach, 'Sustainable Development and the United States' in John C Dernbach (ed), *Agenda for a Sustainable America* (Environmental Law Institute 2009) 9.

within these thresholds.¹³⁰ However, it is argued that sustainability is not an appropriate framework for analysing the challenges of social-ecological systems. It lacks capability to provide tools for coping with change, which is seen as an inherent feature of social-ecological systems.¹³¹ In this light, it is claimed that resilience is a ‘substantive advance from the more static notion of sustainable development’.¹³² It provides a frame for a ‘more integrated perspective on the operationalization of sustainable development’.¹³³ Addressing the normative aspect, it is argued that sustainability includes value judgements by finding something to be good and desirable, and that it hence should be sustained.¹³⁴ Accordingly, sustainability has a normative dimension. In comparison, it is argued that resilience as an analytical tool assess the state of a system and its ability to retain core characteristics, not whether these core characteristics are desired or undesired, alternatively sustainable or unsustainable.¹³⁵

From a sustainability perspective, many have argued that it should be the ecological factors that set the conditions for any other development, such as social and economic development.¹³⁶ The resilience perspective also recognises that the ecological factors set the base and thresholds of the social-ecological systems, but it also suggests that the relationship between the different elements of social-ecological systems are more complex.¹³⁷ By using the concept ‘social-ecological’, the interplay between social and ecological systems could be illustrated, without treating either the social or the ecological aspect as a prefix, implying that it should be given more weight in an analysis.¹³⁸ Within resilience research, it is suggested that analysing only the social or the ecological systems will lead to too narrow conclusions, and that will subsequently be insufficient for guiding society towards sustainability.¹³⁹ Indeed, not neglecting the social perspectives may be essential for achieving a sustainable agricultural production. In an agricultural context with private ownership, it is the farmers’ right to manage their property in accordance with their preferences. Hence, it is to a large extent social subjects that ultimately decides (taking into account regulations and market

¹³⁰ Walker and Salt (n 49) 63.

¹³¹ Saxer and Rosenbloom (n 76) 58.

¹³² Humby (n 52) 85.

¹³³ Bohman (n 44) 37.

¹³⁴ Saxer and Rosenbloom (n 76) 58.

¹³⁵ *ibid.*

¹³⁶ See e.g. Klaus Bosselmann, *The Principle of Sustainability: Transforming Law and Governance* (Ashgate, ebook 2008); Klaus Bosselmann, Ron Engel and Prue Taylor, *Governance for Sustainability – Issues, Challenges, Successes* (IUCN Environmental Policy and Law Paper No 70, IUCN Commission on Environmental Law (CEL) and IUCN Environmental Law Centre (ELC) 2008).

¹³⁷ Bohman (n 44) 37.

¹³⁸ Folk and others (n 98) 443.

¹³⁹ *ibid.*

conditions) how much and what pesticides that are to be used on their farmland. Decisions will be influenced by social factors such as economic frameworks, social norms, local conditions etc, and how these factors are perceived by the individual farmer.¹⁴⁰ Another example of an important social aspect is that of agriculture providing viable livelihoods for local people.¹⁴¹ Without that, farmers may be forced to seek livelihood in other activities, perhaps leaving rural areas. Then, the social-ecological system of agriculture will not be able to continue to exist, much less be developing. In such a scenario, one can expect the wider social-ecological system of rural areas to also be affected.

Within research, it is suggested that a social-ecological system that is not resilient is 'unlikely to be sustainable', since a system that is close to one or more thresholds is more likely to experience regime shift and change of its core features, in other words, being unsustainable. On the other hand, 'a system that is unsustainable may still be resilient, although it is likely to be strained'.¹⁴² For example, a system may utilise natural resources in a way that deprives future generations of essential ecosystem services, but the system may still be extremely resilient and resistant to change. There are many examples of economic systems being resilient, while at the same time, they put unsustainable pressures on the ecological systems. The longer unsustainable behaviour continues in a system, the more likely it is that its resilience capacity will decrease.¹⁴³

3.4. Grounds for Criticism of Social-Ecological Resilience Theory

To begin with, it may be questioned why policies should at all be based on the assessment of resilience. One may ask why this specific aspect should be given priority, and be the point of departure for designing policies, and not e.g. economic benefits, social values, development, human rights, or environmental protection?¹⁴⁴

Moreover, governance of social-ecological systems inherently includes aspects of politics and power. Different sectors and groups prefer, need, and demand different values and functions. At the same time, it is not possible to build and increase resilience of all values and functions simultaneously. Decisions about governance of social-ecological systems inevitably require trade-offs, that are inherently political. These trade-offs will be influenced by issues of power and inequality. In light of this, applying social-ecological resilience theory uncritically may implicitly recognise the interests and preferences of some groups, while ignoring the interests and preferences of others. Choosing to build resilience of particular functions or values, e.g. certain ecosystem

¹⁴⁰ Darnhofer, Fairweather and Moller (n 106) 192–193.

¹⁴¹ Angelo and Reilly-Brown (n 96) 724.

¹⁴² Saxer and Rosenbloom (n 76) 56.

¹⁴³ *ibid* 57.

¹⁴⁴ *ibid* 25.

services, human rights, or democracy, comes with an implicit valuation of these functions by certain subjects, done at particular times and places, and this may implicitly disguise the trade-offs included in these choices. Ultimately, this could increase differences in power distribution within society.¹⁴⁵ Thus, initiatives to build resilience have distributional implications, and are a matter of justice within and between generations.¹⁴⁶ In light of this, the complexity of social-ecological resilience theory could also be problematic. ‘Scientisation’ of political trade-offs, i.e. discussing the trade-offs in the specialised language of science, may suppress open discussions of value preferences and delegitimise those without a scientific perspective to further their interests.¹⁴⁷

The potential of social-ecological resilience theory to contribute to governance that keep human activity within the ‘safe operating space’ of the ‘planetary boundaries’, may also be questioned. ‘Some will perhaps see in resilience (...) simply the emergence of a new set of buzzwords that allow us to believe that we are doing something about the long-term ecological degradation of Mother Earth, while very little changes’.¹⁴⁸ Considering that the resilience perspective lacks attention to phenomena such as agency, conflict, and power, it is warned that resilience may be a powerful de-politicising concept in the hands of political actors.¹⁴⁹ In fact, one may ask if uncritically promoting social-ecological resilience could even contribute to transgression of ‘planetary boundaries’. Turning to a concept employed by the post-Marxist political theorist Ernest Laclau, the growing appropriation of the resilience concept, by different disciplines and communities, creates the risk of resilience becoming an ‘empty signifier’. This refers to an idea which is conceptually empty, but has hegemonic status due to its capacity to unify. In other words, the concept can mean everything and nothing, and thus it is easy for everyone to agree upon. This enables different societal interests to believe that they are working towards a common aim, while these aims actually are so contradictory that the signifier does nothing to change status quo.¹⁵⁰

¹⁴⁵ Michael L Schoon and others, ‘Politics and the Resilience of Ecosystem Services’ in Reinette Biggs, Maja Schlüter and Michael L Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 32–34.

¹⁴⁶ *ibid* 35, with reference to Richard B Norgaard, ‘Ecosystem services: From eye-opening metaphor to complexity blinder’ (2010) 69(6) *Ecological economics* 1219.

¹⁴⁷ Schoon and others (n 145) 41, with reference to Michael Gismondi and Mary Richardson, ‘Discourse and power in environmental politics: Public hearings on a bleached kraft pulp mill in Alberta, Canada’ (1991) 2(3) *Capitalism Nature Socialism* 43, and Maria Carmen de Mello Lemos, ‘A tale of two policies: the politics of climate forecasting and drought relief in Ceará, Brazil’ (2003) 36(2) *Policy Sciences* 101, and Daniel Sarewitz, ‘How science makes environmental controversies worse’ (2004) 7(5) *Environmental Science & Policy* 385.

¹⁴⁸ Humby (n 52) 129–130.

¹⁴⁹ Lennart Olsson and others, ‘Why Resilience is Unappealing to Social Science: Theoretical and Empirical Investigations of the Scientific Use of Resilience’ (2015) 14 *Science Advances* 1, 9.

¹⁵⁰ Humby (n 52) 88, with reference to Ernesto Laclau, ‘Ideology and post-Marxism’ (2006) 11(2) *Journal of Political Ideologies* 103.

3.5. Social-Ecological Resilience and the Law

The concepts, rules, procedures, and institutions of legal systems affect the resilience capacity of social-ecological systems. Depending on what the law looks like, it may contribute to the capacity of a system to deal with uncertainties and surprises, to absorb stress and external disturbances, to manage non-linear effects, to cross thresholds, and to adapt to new circumstances.¹⁵¹ There is a consensus that the resilience perspective could serve as a conceptual framework for making the law capable of responding to the complexity and unpredictability of social-ecological systems.¹⁵²

There are often normative ends in legal systems, related to concepts such as justice and the rule of law.¹⁵³ The rule of law implies constraints on the power of government and is often understood as ensuring legal certainty and predictability. By that, it should be possible for individuals in the legal system to know what is permitted, ordered, prohibited, etc., and from that choose and adjust their behaviour. Legal certainty is argued to be essential for providing trust in government and for making it possible for individuals to plan their behaviour without unexpected public interference, or interference from other individuals.¹⁵⁴ Moreover, in many legal systems, the law often seeks to protect values such as equality before the law and non-discrimination. The law is also used as an instrument to achieve various environmental and social objectives, e.g. protecting biodiversity; enhancing the competitiveness of an industry sector; or establishing a functioning market.¹⁵⁵ In the light of these aspects, the law may be considered important for providing social stability and stability in human interactions. If viewing democracy, economic stability, and general development as parts of the resilience of social systems, these features of rule of law and legal certainty are essential from a social-ecological resilience perspective.¹⁵⁶

However, these traditional legal features may at the same time decrease the overall resilience capacity of social-ecological systems. Features that has been identified to foster resilience are, inter alia, flexibility in social systems and institutions (in order to deal with change); openness of institutions (so as to provide for extensive participation and effective multi-level governance); and social structures that promote learning and adaptability (without limiting options for future

¹⁵¹ Jonas Ebbesson and Ellen Hey, 'Introduction: Where in Law is Social-Ecological Resilience?' (2013) 18(3): 25 *Ecology and Society*.

¹⁵² Humby (n 52) 105.

¹⁵³ Ebbesson and Hey (n 151).

¹⁵⁴ Jonas Ebbesson, 'The Rule of Law in Governance of Complex Socio-Ecological Changes' (2010) 20 *Global Environmental Change* 414, 415, with references to Joseph Raz, 'The rule of law and its virtue' (1977) 93(2) *The Law Quarterly Review* 195, 195–211 and, Ronald Dworkin, *Law's Empire* (Harvard University Press 1986).

¹⁵⁵ Ebbesson and Hey (n 151).

¹⁵⁶ Bohman (n 44) 379.

development).¹⁵⁷ Thus, linking resilience theory with legal research means joining two domains that comes with a variety of different normative values. It is however concluded that the law, as such, does not necessarily hinder ambitions to create resilient social-ecological systems, but it depends on the content of the rules and the institutions that are set up. Moreover, the static character of the law should be nuanced. In law, there is always room for a certain amount of interpretation, sometimes wider and sometimes narrower. Applying the law includes different arguments, from different sources, and weighing those against each other to determine which particular interpretation that should triumph.¹⁵⁸

Despite being embraced by legal scholars as an analytical framework, it is nevertheless questioned if the resilience perspective can be applied in equal manners to both ecological systems and social systems (such as the law). It is argued that the resilience perspective fails to acknowledge essential differences between social and ecological systems. Many of the concepts related to resilience was established in the field of ecology and resilience of social systems may rely upon fundamentally different factors than resilience of ecological systems.¹⁵⁹ Since social systems are socially constructed, results of human ideas and thoughts, it is argued that the understanding of them is fundamentally different.¹⁶⁰ This implies possible risks of applying social-ecological resilience theory in legal research, calling for caution and close scrutiny of the accuracy of such analysis.

¹⁵⁷ Ebbesson and Hey (n 151).

¹⁵⁸ Ebbesson (n 154) 421.

¹⁵⁹ Bohman (n 44) 43.

¹⁶⁰ Saxer and Rosenbloom (n 76) 25, with reference to Olsson and others (n 149).

4. ANALYSIS

In the light of social-ecological resilience theory, it is suggested that the law, inter alia, should be adaptive. Adaptive law theory constitutes the basis for this analysis of EU pesticides law. More specifically, certain criteria developed within legal research for measuring resilience and adaptive capacity of regulatory instruments are employed. These criteria address a number of features related to substance, procedure, complementary instruments, and enforcement, identified to contribute to the resilience and adaptive capacity of legal instruments. In this section, adaptive law theories, as well as the chosen evaluative criteria, are presented. After a brief introduction of the EU legal instruments governing agricultural pesticide usage, these instruments are evaluated against the chosen criteria. During this analysis, the criteria are addressed in further detail and contextualised against the broader perspective of social-ecological resilience theory.

4.1. Adaptive Law for Social-Ecological Resilience?

What are the implications of social-ecological resilience theory for the law? What should the law be in order to contribute to the resilience of social-ecological systems? The importance of institutional design and legitimacy, as well as of linking resilience thinking with resource allocation regimes and environmental protection, have been put forward as themes that deserve attention.¹⁶¹ Another implication that has been acknowledged is the need for the law to be adaptive.¹⁶² This evaluation of EU pesticides law will be limited to the perspective provided by adaptive law theory, which includes a wide range of aspects considered to be important for building social-ecological resilience. An evaluation employing this perspective should however not be considered exhaustive in a resilience perspective. For example, fostering complex adaptive systems thinking, which is considered a key principle for resilience building, is not explicitly present in adaptive law theories.¹⁶³ Another example is that the aspect of transformability, i.e. the capacity to cross thresholds and enter into new stable states, is vaguely reflected.¹⁶⁴ In adaptive law theory it seems that the focus is rather on development along the current stable state. Consequently, in an analysis based on adaptive law theory there is a

¹⁶¹ Ahjond S Garmestani, Craig R Allen and Melinda H Benson, 'Can Law Foster Social-Ecological Resilience?' (2013) 18(2): 37 Ecology and Society.

¹⁶² See, inter alia, Bohman (n 44) 38; Soininen and Platjouw (n 75) 12; Craig Anthony Arnold and Lance H Gunderson, 'Adaptive Law and Resilience' (2013) 43(5) Environmental Law Reporter 10426, 10428.

¹⁶³ Erin L Bohensky and others, 'Principle 4 – Foster Complex Adaptive Systems Thinking' in Maja Schlüter, Michael L Schoon and Reinette Biggs (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 142ff.

¹⁶⁴ See above section 3.2.

risk that the resilience aspect of transformability is overlooked. Finally, one shall note that resilience may be reflected in governance measures and other structures, beyond the law.¹⁶⁵ Law is only one of many factors that affect the capacity of social-ecological systems to handle uncertainty and change.¹⁶⁶

The insights of research on the dynamics of social-ecological systems have led to an interest in the concept of adaptive law. The slow down effect that law often has in relation to change may be helpful to absorb shocks and disturbances up to a certain point. However, the insights on the scale and pace of change in social-ecological systems, more specifically characterised as abrupt, unexpected, and non-linear, require the law to be flexible and adaptive. If not, the law can contribute to ecological collapse and subsequently social collapse.¹⁶⁷ This call for adaptivity may however be a challenge to the law. In the light of adaptive law theory, certain common deficiencies of the law have been identified. They have been categorised into

- 1) the perspectives on nature,
- 2) substantive goals,
- 3) the structure of governing authority, and
- 4) structuring of legal practice and decision-making.¹⁶⁸

Shortly, the incorrect perspective of nature refers to an incorrect view of ecological systems, and their links to social systems.¹⁶⁹ For example, the foundations of U.S. environmental law reflect assumptions of nature as relatively stable, that the nature is predictable, and mostly changes in a linear way.¹⁷⁰ In regards of substantive goals, they are considered to be too focused on ensuring stability, certainty, and security of supply. The law generally mandates optimal use of natural resources, not only in regards of one interest, but optimisation in regards of several interests. This weakens the resilience of the ecological systems, and subsequently the resilience of social-ecological systems.¹⁷¹ Structure of governing authority refers to the extent that the law centralises power, the modes in which the law allows an authority to exercise power, and how governing authorities operate

¹⁶⁵ Bohman (n 44) 394.

¹⁶⁶ Ebbesson and Hey (n 151).

¹⁶⁷ Arnold and Gunderson (n 162) 10427, with reference to Lance Gunderson and others, 'Water RATs (resilience, adaptability, and transformability) in lake and wetland social-ecological systems' (2006) 11(1): 16 Ecology and Society.

¹⁶⁸ Humby (n 52) 107.

¹⁶⁹ *ibid* 107–108.

¹⁷⁰ Arnold and Gunderson (n 162) 10426, with references to JB Ruhl, 'Climate change and the Endangered Species Act: building bridges to the no-analog future' (2008) 88 BUL Rev 1; Robin Kundis Craig, 'Stationarity is dead – long live transformation: five principles for climate change adaptation law' (2010) 34 Harv Envtl L Rev 9.

¹⁷¹ Humby (n 52) 108–109.

across different scales. More specific issues that are identified are preferences for strong centralised government, which is often not matched to the scale, scope, and speed at which stress occurs in social-ecological systems. Another issue is the approach of choosing one particular mode, instrument, or method as the ‘optimal’, i.e. a one-size-fits-all approach. This is suggested to increase vulnerability and to weaken the capacity to address the complexity and the unpredictability of social-ecological systems.¹⁷² Finally, the nature of legal processes and legal values may hinder adaptivity. It is claimed to be a tendency for establishing pre-determined, linear, pathways for planning and development within the law. This may seem rational, but assumes stationarity and predictability of ecological and social systems.¹⁷³ Moreover, environmental law and natural resource law also often lack efficient feedback-loops, or if they exist, they are not utilised.¹⁷⁴

Turning a critical lens on adaptive law theory, one may note that adaptive law, as a theoretical concept, is neutral. Nevertheless, inherent in resilience building are trade-offs between different values and functions.¹⁷⁵ Thus, a strong call for adaptive law raises the question of adaptivity for whom? In regards of what interests and preferences will the law provide adaptivity? Adaptivity may further the preferences of the environmentalist, or it may further the interests of the industrialist that want to derogate from environmental protection measures.¹⁷⁶ For example, access to justice is considered as one feature that should be included in adaptive law.¹⁷⁷ Relating this to the field at issue, judicial reviews of approvals and non-approvals of pesticide substances are regularly initiated under EU law. Of 74 cases initiated between 2003 and 2013, 1 case was initiated by a Member State, 5 cases by non-governmental organisations (NGOs), and 68 cases by the industry.¹⁷⁸ These numbers call for further attention to the lack of knowledge on how adaptive law affects resolution of conflicts. The relationship between, on the one hand, resilience including adaptive law, and, on the other hand, environmental human rights and environmental justice, has not been explored. It is not clear how adaptive law embeds in relations and distributions of power, and in what ways it allows for conflict resolution.¹⁷⁹ Until these aspects have been investigated, it is called for great attention to the policy

¹⁷² *ibid* 110–112.

¹⁷³ *ibid* 114, with references to Arnold and Gunderson (n 162) 10436, and JB Ruhl, ‘General Design Principles for Resilience and Adaptive Capacity in Legal Systems – with Applications to Climate Change Adaptation’ (2011) 89(5) *North Carolina Law Review* 1373, 1393.

¹⁷⁴ Humby (n 52) 114, with reference to Arnold and Gunderson (n 162) 10440.

¹⁷⁵ See above section 3.4.

¹⁷⁶ Soinen and Platjouw (n 75) 29.

¹⁷⁷ See below sections 4.3 and 4.6.4.

¹⁷⁸ Laurence Cordier, ‘Implementation of EU Plant Protection Legislation’ (DG Health and Consumers, European Commission) <www.aca-europe.eu/seminars/Parma2013/Table2_Cordier.pdf> accessed 10 May 2019.

¹⁷⁹ Humby (n 52) 129.

choices made in regards of regulatory goals and tools, since the answer to the question of ‘adaptive law for whom?’ may be revealed by studying these processes.¹⁸⁰

4.2. A Developed Understanding of Adaptive Law

What shall adaptive law look like? Soininen and Platjouw suggest a developed understanding of adaptivity, that it should be granted a dual meaning in relation to the law. On the one hand, the law needs to be adaptive to changes and new knowledge. In that aspect, legal certainty may be a hindrance. The theoretical conceptions of rule of law aim to impose certainty on a social-ecological reality that is uncertain, inter alia, by crafting legal rules for withstanding unexpected environmental, social, economic, and cultural changes, strict procedural rules as concerns evaluating evidence and burden of proof, as well as strict criteria for legal argumentation.¹⁸¹ On the other hand, the management of social-ecological systems needs to be adaptive to the law. The functions of predictability and permanence is required in certain situations, as opposed to always requiring adaptivity.¹⁸² It is essential mainly in relation to three aspects, namely

- 1) to safeguard legitimate expectations of different actors,
- 2) to control administrative and judicial powers, and
- 3) to effectively drive change.¹⁸³

Without these functions, neither knowledge, nor changes of the law, will effectively contribute to social-ecological resilience.¹⁸⁴ Thus, rule of law and legal certainty may be crucial for adaptation of social behaviour, and subsequently for ensuring resilience capacity. With this perspective, adaptivity shall not only mean that the law should be adaptive in relation to dynamics ‘external’ to the law, but that human behaviour shall be adaptive to requirements of the law. As Soininen and Platjouw conclude, ‘law should be a careful combination of adaptivity and certainty, rule of science and rule of law’.¹⁸⁵

¹⁸⁰ Soininen and Platjouw (n 75) 29–30.

¹⁸¹ *ibid* 25; Niko Soininen, ‘Torn by (Un)Certainty – Can There Be Peace Between Rule of Law and Other Sustainable Development Goals?’ in Duncan French and Louis J Kotzé (eds), *Sustainable Development Goals: Law, Theory and Implementation* (Edward Elgar 2018) 269.

¹⁸² Soininen and Platjouw (n 75) 29.

¹⁸³ *ibid* 25.

¹⁸⁴ *ibid* 26.

¹⁸⁵ *ibid* 25–26.

4.3. Establishing Evaluative Criteria

How shall adaptive capacity of the law be measured? While general perspectives of social-ecological resilience theory and adaptive law have been presented in previous sections, more concrete tools are needed for evaluating EU pesticides law. For their research on EU aquatic environmental law, Soininen and Platjouw identify a number of legal features that contribute to adaptive and resilience capacity of the law. In the light of this, they suggest a number of specific criteria for measuring resilience and adaptivity of environmental regulatory instruments. Divided into four categories, these are:

1. *Substance*

- a. Plurality of goals, or goals of narrow scope coupled with exemptions
- b. Discretion to adjust management in the light of new scientific understanding

2. *Procedure*

- a. Increasing knowledge
- b. Iteration
- c. Crossing sectoral, jurisdictional and public/private boundaries
- d. Access to information and justice

3. *Instrument Choice*

- a. Direct regulation coupled with economic and voluntary instruments

4. *Enforcement*

- a. Legally binding and specific obligations to achieve procedural and substantive goals
- b. Time limits for goals
- c. Sanctioning of non-compliance

These criteria are identified through a synthesis of the main observations and requirements put forward in academic literature and policy documents on ‘law and resilience’.¹⁸⁶ These criteria are

¹⁸⁶ *ibid* 26. In the discussion preceding the suggested criteria, references are made, inter alia, to Craig (n 170); Arnold and Gunderson (n 162); Jan McDonald and Megan C Styles, ‘Legal Strategies for Adaptive Management under Climate Change’ (2014) 26(1) *Journal of Environmental Law* 25; Ruhl (n 173); Andrea M Keesen and Helena FMW van Rijswijk, ‘Adaptation to Climate Change in European Water Law and Policy’ (2012) 8 *Utrecht L Rev* 38; Lorenzo Squintani and Helena van Rijswijk, ‘Improving Legal Certainty and Adaptability in the Programmatic Approach’ (2016) 28(3) *Journal of*

appealing because they boil down abstract principles for governance for social-ecological resilience to fairly clear and distinctive analytical tools developed specifically with regards to analysing legal instruments. Since the research object is not the law in general, or a wider legal structure, but specific legal instruments, these criteria constitute an appropriate base for the analysis. One may note that these criteria are explicitly addressed toward environmental regulation, while the regulation at hand has several purposes and cannot be considered an exclusively environmental regulation. However, these criteria are distilled from a theory that aims to balance the behaviour of social systems with the behaviour of ecological systems, rather than solely promoting ecological primacy.¹⁸⁷ In this light, these criteria should be an appropriate analytical framework for fulfilling the aim of this thesis, i.e. to explore how EU pesticides law may be improved, including answering the chosen research questions.

One shall however note that these evaluative criteria do not address all aspects that may be of relevance in evaluating the resilience capacity of EU pesticides law. These criteria are a selection of aspects, a distillation, of a broad and abstract theoretical framework. Thus, elements and aspects of relevance may be left out of the criteria, and consequently overlooked, which calls for cautiousness when recognising the results of this analysis. Nevertheless, these criteria are a valuable attempt to provide practical and accessible tools for evaluating specific legal instruments. The criteria are based upon, and include, central aspects of the resilience perspective that are of relevance in a legal context. Thus, they shall be able to provide a valuable indication of the resilience and adaptive capacity of EU pesticides law.

The meaning of these criteria is further explained below, based on the discussion by Soininen and Platjouw and the references made therein. To put the criteria into context, and shed light on their importance from a broader resilience perspective, they are briefly related to general key principles for resilience building in social-ecological systems. The criteria are also problematised from the perspective of ‘planetary boundaries’, as well as from other interpretations of what social-ecological resilience theory imply for the law.

Environmental Law 443; Katherine Pasteur, *From Vulnerability to Resilience. A Framework for Analysis and Action to Build Community Resilience* (Practical Action Publishing 2011); Froukje Maria Platjouw, ‘Marine Spatial Planning in the North Sea — Are National Policies and Legal Structures Compatible Enough? The Case of Norway and the Netherlands’ (2018) 33(1) *The International Journal of Marine and Coastal Law* 34; Soininen (n 181); Hans Christian Bugge, ‘Twelve Fundamental Challenges in Environmental Law’ in Christina Voigt (ed), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law* (Cambridge University Press 2013) 3; Ebbesson (n 154); Barbara Cosens, ‘Transboundary River Governance in the Face of Uncertainty: Resilience Theory and the Columbia River Treaty’ (2010) 30 *J Land Resources & Envtl L* 229.

¹⁸⁷ See above section 3.3.

4.4. Fundamentals of EU Pesticides Law

In this section, the basic characteristics of Regulation 1107/2009 on the ‘Placing on the Market of Plant Protection Products’ (PPPs) (PPP Regulation) and Directive 2009/128/EC on the ‘Sustainable Use of Pesticides’ (SUD) are presented. Shortly, the PPP Regulation lays down rules for authorising the sale of PPPs, as well as the use and control of these products. The SUD sets out rules for the sustainable use of pesticides, including PPPs. In other words, they together lay down rules on both the pre-market and post-market phases of PPPs. As regards the relationship between them, the rules laid down in SUD should be ‘complementary to, and not affect’ the measures of the PPP Regulation.¹⁸⁸ This regulatory package is informed by five normative principles for risk assessment and management. It is argued that these key principles make EU pesticide regulation distinctive in comparison with pesticide regulations of other jurisdictions.¹⁸⁹ These principles, further addressed below, are

1. hazard identification,
2. precaution,
3. substitution,
4. sustainability, and
5. mutual recognition.

It is the intended use of a product, not its properties, that determines whether a product should be considered a PPP, and hence if the PPP Regulation applies.¹⁹⁰ The PPP Regulation defines PPPs as products intended for one of the following uses,

- 1) protecting plants or plant products against pests and/or diseases, before or after harvest,
- 2) influencing the life process of a plant (e.g. influencing their growth, excluding nutrients)
- 3) preserving plant products, or
- 4) destroying or preventing growth of undesired plants/parts of plants.¹⁹¹

¹⁸⁸ SUD, recital 3.

¹⁸⁹ Bozzini (n 1) 27.

¹⁹⁰ PPP Reg, art 2.1.

¹⁹¹ *ibid.*

The rationale behind a pre-market authorisation of PPPs is to prevent risks already at the source, by only putting safe substances on the market. By this pre-market approach, the risk of harmful effects is expected to be minimised.¹⁹²

The authorisation process is carried out within a dual system, where the competence is split between the EU level and the Member State level. A PPP is usually made up several components, where the component intended to give effect against pests is called ‘active substance’.¹⁹³ Active substances are authorised at the EU level according to harmonised rules.¹⁹⁴ The same authorisation procedure is prescribed for safeners and synergists. The former term refers to chemicals used to reduce the effects of the PPP on certain plants. The latter term refers to chemicals added to improve the functioning of the active substance of a PPP.¹⁹⁵ The PPP, the specific commercial product that contain active substances as ingredients, are authorised at Member State level.¹⁹⁶

The assessment of active substances is guided by a hazard-based approach. Hazard is defined as the intrinsic potential of a substance to cause harm.¹⁹⁷ A hazard-based approach essentially means that there are risks that are unacceptable and consequently should not be taken, even though it is unlikely that harmful effects or accidents will occur. In comparison, a risk-based approach is focused on the likelihood of harm under specific circumstances. This approach accepts that risks will occur, and sometimes have to be taken, but that it is possible to assess and manage them.¹⁹⁸ The hazard-based approach of the PPP Regulation differs with the traditional approach in chemicals and product regulation, inter alia within the U.S., which has been that of a risk-based approach. In a risk-based approach, hazard identification is only the start of the authorisation process, not automatically triggering a ban of the substance or the product.¹⁹⁹ In contrast, the PPP Regulation identify seven hazards that are considered unacceptable, referred to as ‘cut-off criteria’. If an active substance meets

¹⁹² Bozzini (n 1).

¹⁹³ PPP Reg, art 2.2.

¹⁹⁴ *ibid*, art 13.

¹⁹⁵ *ibid*, art 25.

¹⁹⁶ *ibid*, art 28.1.

¹⁹⁷ Bozzini (n 1) 30, with reference to Commission, ‘Communication from the Commission to the European Parliament and the Council on endocrine disruptors and the draft Commission acts setting out scientific criteria for their determination in the context of the EU legislation on plant protection products and biocidal products’ COM (2016) 350 final, 7.

¹⁹⁸ Bozzini (n 1) 30; Ragnar E Lofstedt, ‘Risk versus Hazard – How to Regulate in the 21st Century’ (2011) 2(2) *European Journal of Risk Regulation* 149, 149.

¹⁹⁹ Kristina Nordlander, Carl-Michael Simon and Hazel Pearson, ‘Hazard v. Risk in EU Chemicals Regulation’ (2010) 3 *European Journal of Risk Regulation* 239, 249.

any of these criteria, it is banned without any further assessment of the likelihood of harmful effects to occur.²⁰⁰

This hazard-based approach goes hand in hand with another principle informing the pre-market approval of PPPs, namely the precautionary principle. This principle is put forward as a key norm in both the PPP Regulation and the SUD.²⁰¹ A basic understanding of this principle is that regulatory action shall be taken, and that it shall aim to reduce potential harm, when there are scientific uncertainty over risks associated with a certain product and it is not possible to establish whether using the product is safe.²⁰² As concerns burden of proof, the precautionary principle means that those who want to put an active substance on the market have the burden of proof to provide evidence that it is safe.²⁰³ The precautionary principle, as it is endorsed in EU pesticides regulation, does not seem to acknowledge any cost-benefit analysis to be relevant in approvals. Indeed, Bozzini claims that balancing health and environmental considerations against economic considerations has no legitimacy.²⁰⁴ In this light, Bozzini argues that EU pesticides regulation embraces a ‘strong’ version of the precautionary principle.²⁰⁵

The EU has not only taken regulatory action in regards to the pre-market stage of PPPs, but also to the post-market phase i.e. the whole ‘pesticide chain’. The overarching aims of regulating the post-market stage are to phase out chemicals of concern by substituting them with safer alternatives – as well as to reduce the overall use of pesticides. The principle of substitution is endorsed in the PPP Regulation which obligates the Commission to list active substances of concern. Despite legally being deemed safe, these substances are considered to come with risks that might be difficult to handle, hence they are considered ‘candidates for substitution’.²⁰⁶ If a PPP contains an active substance that is a candidate for substitution, a comparative assessment including both agronomic and economic aspects shall be carried out at Member State level. An authorisation of a PPP containing an active substance of concern shall not be granted if there are safer chemical, or non-chemical alternatives or other prevention methods.²⁰⁷

The principle of substitution is expected to contribute to the overall aim of EU pesticides regulation to achieve a sustainable use of pesticides. This aim is the specific goal of the SUD. The main tool for achieving this goal is obligating the Member States to adopt National Action

²⁰⁰ Bozzini (n 1) 30–31; PPP Reg, Annex II 3.6–10.

²⁰¹ PPP Reg, art 1.4; SUD, art 2.3.

²⁰² Bozzini (n 1) 33.

²⁰³ *ibid* 37; PPP Reg, art 8.

²⁰⁴ Bozzini (n 1) 35.

²⁰⁵ *ibid* 38.

²⁰⁶ *ibid* 39; PPP Reg, art 24.

²⁰⁷ PPP Reg, recital 19.

Plans (NAPs), including quantitative objectives, targets, measures timetables and indicators, for achieving a sustainable use of pesticides.²⁰⁸ The SUD also contain specific provisions, inter alia, prohibiting aerial spraying while promoting Integrated Pest Management (IPM).²⁰⁹ IPM is a set of practices, centred around reduction of chemical use, and anticipation and prevention of pests, varying depending on the local conditions.²¹⁰

Finally, EU pesticides regulation is informed by a peculiar version of mutual recognition. The meaning of this principle is, shortly, the acceptance by Member States of rules and standards, adopted by other Member States, as equivalent to their own. This principle is one of the key means that has built the current EU internal market.²¹¹ In relation to PPPs, authorisations by one Member State shall be accepted by other Member States where ‘agriculture, plant health and environmental (including climatic) conditions are comparable’.²¹² This differs with the standard version of mutual recognition, whereby national rules are deemed equivalent across all Member States. Instead, as concerns PPPs, the Union is divided into three zones – north, centre, and south – and within each, the principle of mutual recognition applies.²¹³ To clarify, if a PPP is authorised in a Member State belonging to the north zone, the producer of the PPP can have it equally authorised in all Member States of the north zone. However, to enter into the market of Member States in the centre or the south zone, the producer will have to start a new authorisation procedure.

In the following sections, the PPP Regulation and the SUD are evaluated against the adaptive law criteria presented above, in order to measure the adaptive and resilience capacity of these instruments.

4.5. Substance

4.5.1. *Plurality of Substantive Goals*

Diversity is generally emphasised within social-ecological resilience theory as an important feature of resilience building. Broadly, diversity refers to the different numbers of components, as well as the level of heterogeneity among components, within social-ecological systems. The reason for the endorsement of diversity is that it is suggested to provide options for responding to change and

²⁰⁸ SUD, art 4.1.

²⁰⁹ SUD, arts 9 and 14.

²¹⁰ Bozzini (n 1) 42; SUD, art 3.6.

²¹¹ Bozzini (n 1) 43.

²¹² PPP Reg, art 40.

²¹³ Bozzini (n 1) 43; PPP Reg, Annex I.

disturbance.²¹⁴ Soininen and Platjouw put forward plurality and diversity as important in regards to the goal (or goals) attached to a regulatory instrument. They suggest that the substantive goals should simultaneously acknowledge environmental, social, and economic aspects.²¹⁵ At the same time, the goals should be clear so that the legality of management measures can be judged against the goals.²¹⁶ Two suggestions are put forward by Soininen and Platjouw on how to achieve this. One alternative is to have narrow goals, e.g. ones that are only related to ecological factors, not taking social factors into consideration. These should then be coupled with an exemption regime, in order to handle conflicts with other goals and regulatory instruments. A second option is to formulate goals that are so broad at the outset that they are able to address conflicts between ecological and social considerations.²¹⁷

Critically reflecting upon this criterion, one may ask how compatible substantive goals of diverse character are with the requirement of clear goals, which is also put forward as important. Looking at this criterion from the wider perspective provided by the ‘planetary boundaries’, as well social-ecological resilience theory, further questions may be raised. A resilience perspective does not require that environmental considerations should be granted primacy in all conflicts.²¹⁸ Nevertheless, considering the ‘planetary boundaries’ perspective with certain ecological thresholds, not to be transgressed if not to jeopardise the prerequisites of human well-being, there may be conflicts where it will be required to grant environmental considerations primacy. The resilience perspective also acknowledges that there are ecological limits to the social systems, and consequently that there may be situations when there is a need to limit social activities to keep social-ecological systems within a particular state of stability.²¹⁹ Arguably, only having a plurality of substantive goals, or diverse substantive goals, does not automatically incorporate these insights and requirements. While diversity could provide for options for responding to disturbances and stresses, i.e. enhance resilience capacity, there seems to also be a need for guidance on when certain goals or values should be given priority, or at least an acknowledgement that such situations may arise. It is observed that when

²¹⁴ Karen Kotschy and others, ‘Principle 1 – Maintain Diversity and Redundancy’ in Reinette Biggs, Maja Schlüter and Michael L Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 50–51, with references to Carl Folke, Johan Colding and Fikret Berkes, ‘Synthesis: Building Resilience and Adaptive Capacity in Social-Ecological Systems’ in Fikret Berkes, Johan Colding and Carl Folke (eds), *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* (Cambridge University Press 2003) 352; Walker and Salt (n 49); Jon Norberg and Graeme Cumming, *Complexity Theory for a Sustainable Future* (Columbia University Press 2008).

²¹⁵ Soininen and Platjouw (n 75) 26.

²¹⁶ *ibid.*

²¹⁷ *ibid.*

²¹⁸ Humby (n 52) 109, with reference to Arnold and Gunderson (n 162) 10438.

²¹⁹ Humby (n 52) 109.

priorities have to be made between multiple goals, economic considerations tend to trump ecological conservation.²²⁰ In this light, without acknowledging the dependence on ecological factors, it seems that a plurality of goals potentially could make it more difficult to keep social activities within ecological thresholds.

Leaving this scrutiny of the criterion for applying it in the evaluation of EU pesticides law, it is stated in the PPP Regulation that

the purpose of this Regulation is to ensure a high level of protection of both human and animal health and the environment and to improve the functioning of the internal market (...) while improving agricultural production.²²¹

To clarify, the Regulation expresses no less than five goals, namely

- 1) high level of protection of human health,
- 2) high level of protection of animal health,
- 3) high level of protection of the environment,
- 4) improving the functioning of the internal market, and
- 5) improving agricultural production.

The wordings of these goals cannot be considered precise and clear. What is a high level of protection? What is an improved functioning of the internal market? And what is an improved agricultural production? These goals are somewhat clarified in the introductory part of the Regulation, where it is stated that

‘this Regulation should ensure that industry demonstrates that substances or products produced or placed on the market do not have any harmful effect on human or animal health or any unacceptable effects on the environment’.²²²

²²⁰ Marilyn Averill, ‘Introduction: Resilience, Law and Natural Resource Management’ (2008) 87(4) *Nebraska Law Review* 821, 824–825.

²²¹ PPP Reg, art 1.3.

²²² *ibid*, recital 8.

Thus, it seems that a ‘high level of protection’ of human and animal health does not allow for substances and products that have *any harmful effect* on human or animal health. In relation to the environment a ‘high level of protection’ seems to have a different meaning, namely to not allow for *any unacceptable effects*. What constitutes an ‘unacceptable’ effect is not explicit, but it may be understood against the cut-off criteria to be effects related to, inter alia, persistence, bioaccumulation, long-range environmental transport, and toxicity.²²³

As regards the relationship between ‘animal health’ and the ‘environment’, it is not explicit what animals the term ‘animal health’ refers to. Should animals not be considered part of the environment? The ‘environment’ is defined as

waters (including ground, surface, transitional, coastal and marine), sediment, soil, air, land, wild species of fauna and flora, and any interrelationship between them, and any relationship with other living organisms.²²⁴

Reading ‘animal health’ ‘a contrario’, in conjunction with this definition, ‘animal health’ seems to mean the health of those animals that are not wild, i.e. domesticated animals.

The goal of ‘improving the functioning of the internal market’ seems to more specifically mean

‘(...) remove as far as possible obstacles to trade in plant protection products existing due to the different levels of protection in the Member States (...). The purpose of this Regulation is thus to increase the free movement of such products and availability of these products in the Member States’.²²⁵

The goal of ‘improving agricultural production’ seems to more specifically mean ‘safeguard the competitiveness of Community agriculture’.²²⁶ One may note that the use of plant protection products is acknowledged as ‘one of the most important ways’ of improving agricultural production.²²⁷

²²³ *ibid*, Annex II 3.6.2–3.6.5, 3.7.

²²⁴ *ibid*, art 3.13.

²²⁵ *ibid*, recital 9.

²²⁶ *ibid*, recital 8.

²²⁷ *ibid*, recital 6.

From the wording of the provision stating the goals, all goals appear to be on an equal standing. However, that seems to not actually be the intention of the EU legislator. It is expressed that the aim to ‘ensure a high standard of protection’ implies ‘in particular, when granting authorisations of plant protection products, the objective of protecting human and animal health and the environment should take priority over the objective of improving plant production’.²²⁸ This expression, indicating a certain hierarchy between the goals, could possibly constrain the plurality and diversity of the goals and subsequently reduce the Regulation’s capacity of flexibility and adaptivity.

As regards the goal of the SUD, it is shortly stated ‘this Directive establishes a framework to achieve a sustainable use of pesticides (...)’.²²⁹ What a ‘sustainable use’ of pesticides actually means is not clarified anywhere in the Directive. In the recitals of the Directive it is stated that

‘this Directive seeks to promote the integration into Community policies of a high level of environmental protection in accordance with the principle of sustainable development as laid down in Article 37 of that Charter’.²³⁰

What ‘sustainable development’ means is not defined anywhere in the Charter. However, the means that shall be used for achieving ‘sustainable use’ of pesticides may provide some indication of the intention of the EU legislator. It is stated that sustainable use shall be achieved

‘by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides’.²³¹

Moreover, in the recitals of the SUD it is stated ‘(...) the objective of this Directive, namely to protect human health and the environment from possible risks associated with the use of pesticides, (...)’.²³² An ‘a contrario’ reading of these provisions indicates that social and economic aspects shall be excluded from the meaning of ‘sustainable use’, even though this is not explicitly stated anywhere

²²⁸ *ibid*, recital 24.

²²⁹ SUB, art 1.

²³⁰ *ibid*, recital 23.

²³¹ *ibid*, art 1.

²³² *ibid*, recital 22.

in the SUD. The Directive is also adopted solely upon the legal base of Article 175 of the Treaty Establishing the European Community, currently Article 192 of the Treaty on the Functioning of the European Union (TFEU), which is the legal base for adopting environmental measures.

Consequently, the intention of the EU legislator seems to be that ‘sustainable use’ should refer to environmental and human health effects of pesticides usage.

To sum up, together, the PPP Regulation and the SUD have a diverse set of goals where ecological objectives are coupled with social objectives. They are so broad that they at the outset are able to address conflicts between ecological and social considerations. These overall goals are however, general and ambiguous. By turning to interpretative aids, such as recitals, and by employing systemic and teleological methods of interpretation, these goals are to some extent clarified. Nevertheless, a considerable amount of vagueness remains. To conclude, this plurality in the substantive goals indicates adaptive capacity of these legal instruments. At the same time, the ambiguity of the goals will likely make it complicated to judge the legality of management measures taken. The lack of clarity could also make enforcement of the goals challenging, which in turn could hamper adaptivity of human activity to requirements of the law.

4.5.2. Discretion to Adjust Management in the Light of New Scientific Knowledge

According to social-ecological resilience theory, the knowledge of social-ecological systems is partial and incomplete. Revising existing knowledge is continuously needed in order to enable adaption to change.²³³ In this light, encouragement of learning is put forward as a key principle for building resilience in social-ecological systems. Evidence suggests that if governance and decisions-making are influenced by learning, the resilience of desired functions and values, such as ecosystem services, may be enhanced.²³⁴ Accordingly, adaptive law theory often suggests flexible standards, or principles, that allow managers discretion to consider the insights of new scientific knowledge.²³⁵

However, one may note a vagueness in the formulation of the criterion ‘discretion to adjust management in the light of new scientific understanding’. It is not clear whether scientific understanding includes insights and knowledge from the social sciences, such as economics, psychology, or law. Intuitively, one may assume that scientific understanding refers to new insights in the natural sciences. However, considering the very foundation of social-ecological resilience theory,

²³³ Georgina Cundill and others, ‘Principle 5 – Encourage Learning’ in ReINETTE Biggs, Maja Schlüter and Michael L. Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 175, with references to Walker and Salt (n 49); F Stuart Chapin and others (eds), *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World* (Springer Science & Business Media 2009).

²³⁴ Cundill and others (n 233) 174.

²³⁵ Arnold and Gunderson (n 162) 10436.

i.e. the view of social and ecological systems as connected and inevitably intertwined, it seems essential to also include insights from the social sciences about the social systems. Such knowledge could concern the effects of certain types governance measures or certain management decisions. This could be important e.g. in order to understand and predict the feedback that governance or legal measures will have on the ecological systems, and consequently provide knowledge of the capacity to steer human behaviour away from the transgression of ‘planetary boundaries’.

Turning to the analysis of the legal instruments, several provisions that allow for adjustment of management measures in the light of new scientific knowledge are included in the PPP Regulation. To begin with, it is laid down that

the Commission may review the approval of an active substance at any time. It shall take into account the request of a Member State to review, in the light of new scientific and technical knowledge and monitoring data, the approval of an active substance, including where, after the review of the authorisations pursuant to Article 44(1), there are indications that the achievement of the objectives established in accordance with Article 4(1)(a)(iv) and (b)(i) and Article 7(2) and (3) of Directive 2000/60/EC is compromised. (...) Where the Commission concludes that the approval criteria provided for in Article 4 are no longer satisfied, or the further information required in accordance with Article 6(f) has not been provided, a Regulation to withdraw or amend the approval shall be adopted (...).²³⁶

To clarify, Directive 2000/60/EC (the EU Water Directive) concerns good-quality water in Europe, inter alia laying down rules to stop the deterioration of EU water bodies,²³⁷ while Art 44(1) concerns the authorisation of PPPs.

With regards to renewals of approvals, it is specifically pointed out in the recitals that ‘experienced gained from the actual use of plant protection products containing the substances concerned’ and ‘any developments in science and technology’ should be taken into account when decision is taken regarding renewal of an approval.²³⁸

²³⁶ PPP Reg, art 21.1 and 21.3.

²³⁷ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy [2000] OJ L327/1.

²³⁸ PPP Reg, recital 15.

There is also a review clause regarding authorisations of PPPs. It similarly reads

Member States may review an authorisation at any time where there are indications that a requirement referred to in Article 29 is no longer satisfied. A Member State shall review an authorisation where it concludes that the objectives of Article 4(1)(a)(iv) and (b)(i) and Article 7(2) and (3) of Directive 2000/60/EC may not be achieved. (...) The Member State shall withdraw or amend the authorisation, as appropriate, where: (...) (d) on the basis of developments in scientific and technical knowledge, the manner of use and amounts used can be modified (...).²³⁹

The PPP Regulation also lays down that ‘emergency measures’, i.e. measures to restrict or prohibit the use and/or sale of an active substance or product shall be taken immediately, ‘where it is clear that an approved active substance, safener, synergist or co-formulant or a plant protection product which has been authorized (...) is likely to constitute a serious risk to human or animal health or the environment’.²⁴⁰

Provisions allowing for consideration of new scientific knowledge are also found in the SUD. It is stated that measures shall be adopted to amend non-essential elements of the Directive, in order to take account of scientific and technical progress. This shall be done in regards to training of professional users, distributors and advisors, inspections of equipment in use, integrated pest management, and risk indicators.²⁴¹

To sum up, the pesticide package as a whole, and especially the PPP Regulation, allows for consideration of new scientific knowledge and adjustment to governance measures in light of such new knowledge. This includes the measures of approval of active substances and authorisation of PPPs, which is the primary means for achieving the goals set out in the Regulation. Consideration of new scientific knowledge is also allowed in regards of sub-measures employed for achieving sustainable use of pesticides. In this light, these instruments meet this criterion which contributes to their resilience and adaptive capacity.

²³⁹ *ibid.*, arts 44.1 and 44.3.

²⁴⁰ *ibid.*, arts 69–71.

²⁴¹ SUD, arts 5.3, 8.7, 14.4 and 15.1.

4.6. Procedure

4.6.1. Increasing Knowledge and Iterative Management

In light of learning being a key principle for resilience building (see previous section), the law needs to provide tools and certain procedures for enabling this. Accordingly, iterative management processes that facilitates learning are put forward.²⁴² It is deemed essential that constant monitoring of the environmental media, and the human pressures affecting these, are included in these procedures.²⁴³

Regarding increasing knowledge, the PPP Regulation lays down that producers, suppliers, distributors, importers, and exporters shall keep records of the PPPs that they produce, import, export, store or place on the market for at least 5 years. Furthermore, professional users of PPPs should keep records of the PPPs that they use, including the time and dose of application, as well as the area and the crop where the PPP was used. These records should be kept for at least 3 years. Upon request, this information shall be made available to the competent authority.²⁴⁴ The reasons for these record keeping-obligations are to ensure traceability of potential exposure, increasing the efficiency of monitoring and control, and reducing the costs of monitoring water quality.²⁴⁵ Moreover, producers of PPPs are also obliged to carry out post-authorisation monitoring if it is requested by the competent authority.²⁴⁶ They shall also provide all data relating to the volume of sales of PPPs, in accordance with EU legislation concerning statistics on PPPs.²⁴⁷ Moreover, the holder of an authorisation for a PPP is obligated to notify the Member State of any new information regarding the PPP, or the components included in it, suggesting that the PPP no longer complies with the authorisation criteria, or that the active substance no longer complies with the approval criteria.²⁴⁸ This concerns, in particular, potential harmful effects on human or animal health, groundwater, or their potentially unacceptable effects on plants or plant products or the environment.²⁴⁹ For this purpose, the authorisation holder is required to record and report all suspected adverse reactions in humans, in animals, and in the environment related to the use of the PPP. This obligation to notify includes relevant information from decisions or assessments by international organisations or by public bodies which authorise PPPs in non-EU countries. Information provided by an authorisation holder shall be evaluated at Member State level. If the

²⁴² Soinen and Platjouw (n 75) 26.

²⁴³ Craig (n 170) 40–43.

²⁴⁴ PPP Reg, art 67.1.

²⁴⁵ *ibid*, recital 44.

²⁴⁶ *ibid*, art 67.2.

²⁴⁷ *ibid*, art 67.3.

²⁴⁸ *ibid*, art 56.1.

²⁴⁹ *ibid*, art 56.2.

conditions for approval of an active substance, safener, or synergist is considered to no longer be fulfilled, the Member State shall inform other Member States and the Commission and propose a withdrawal of the approval or amending conditions.²⁵⁰ Finally, the holder of an authorisation shall once a year report to the competent authorities if the holder has any information available that relates to lack of expected efficacy, development of resistance, or any unexpected effects on plants, plant products or the environment.²⁵¹

Regarding iteration, it is laid down that an approval of an active substance shall not be granted for a period longer than 10 years, and a renewal of an approval shall not be granted for a period longer than 15 years (5 years in some cases).²⁵² The same time period applies for approvals of safeners and synergists.²⁵³ The duration of an authorisation of a PPP is linked to the approval period of the active substances, safeners, and synergists it contains. The authorisation period shall not exceed 1 year from the date of expiry of the approval of the substances, safeners, and synergists at issue.²⁵⁴ Finally, one may note that a review clause is laid down, obligating the Commission to present a report (no later than December 2014) on the functioning of the authorisation scheme of the Regulation, in relation to the goals of the Regulation. In that regard, the report may include, if necessary, proposals on appropriate amendments.²⁵⁵

The SUD obligates Member States to adopt NAPs in order to achieve sustainable use of pesticides. These shall include indicators to monitor the use of PPPs containing active substances of particular concern.²⁵⁶ Moreover, it is concluded by the EU legislator that ‘it is necessary to measure the progress achieved in the reduction of risks and adverse impacts from pesticide use for human health and the environment. Appropriate means are harmonised risk indicators that will be established at Community level’.²⁵⁷ Thus, the Commission shall calculate risk indicators at EU level.²⁵⁸ The Commission shall also submit reports to the European Parliament and the Council of the European Union (the Council) on progress in the implementation of the Directive, including proposals for amendments.²⁵⁹

²⁵⁰ *ibid*, art 56.3–4.

²⁵¹ *ibid*, art 56.4.

²⁵² *ibid*, arts 5 and 14.2.

²⁵³ *ibid*, art 25.2.

²⁵⁴ *ibid*, art 32.1.

²⁵⁵ *ibid*, art 82.

²⁵⁶ SUD, art 4.2.

²⁵⁷ *ibid*, recital 20.

²⁵⁸ *ibid*, at 15.4.

²⁵⁹ *ibid*, art 16.

Member States shall use the harmonised indicators for risk management and for reporting.²⁶⁰ They shall calculate harmonised risk indicators, identify trends in the use of certain active substances, and identify priority items, such as substances, crops, regions, or practices that require particular attention. The Member States shall communicate these results to the Commission, to other Member States, as well as make it available to the public.²⁶¹ Member States may continue to use existing national indicators, or adopt appropriate indicators, in addition to harmonised ones.²⁶² Furthermore, Member States are obligated to ‘put in place systems for gathering information on pesticide acute poisoning incidents, as well as chronic poisoning developments where available, among groups that may be exposed regularly to pesticides such as operators, agricultural workers or persons living close to pesticide application areas’.²⁶³ A guidance document (not legally binding) has been published by the Commission concerning the monitoring and surveying of impacts of pesticide use on human health and the environment.²⁶⁴ In this document it is concluded that in order to achieve a proportionate and cost-efficient environmental monitoring, it is essential to make use of data already collected, e.g. data collected in the context of other EU environmental and food safety legislation.²⁶⁵

Regarding iteration of the processes of the SUD, it is laid down that the NAPs should be reviewed at least every five years, and any substantial changes to NAPs shall be reported to the Commission.²⁶⁶ Moving into details and certain features of the NAPs, Member States are obligated to establish procedures for the granting, renewal, and withdrawal of training certificates.²⁶⁷ This implies iteration of the learning processes prescribed for professional users, distributors, and advisors. Moreover, inspections of pesticide application equipment should be done at regular intervals.²⁶⁸

At EU level, as mentioned above, the Commission is assigned a report duty. It shall ‘regularly submit to the European Parliament and to the Council a report on progress in the implementation of this Directive, accompanied where appropriate by proposals for amendments’.²⁶⁹ Specifically, it has been laid down that that the Commission shall submit a report (by November

²⁶⁰ *ibid*, recital 20.

²⁶¹ *ibid*, art 15.2–3.

²⁶² *ibid*, art 15.1.

²⁶³ *ibid*, art 7.2.

²⁶⁴ Commission, ‘Guidance on monitoring and surveying of impacts of pesticide use on human health and the environment under Article 7(3) of Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides (referred to as the Sustainable Use Directive) (Commission Notice) C(2017) 6766 final.

²⁶⁵ *ibid* 8, 11.

²⁶⁶ SUD, art 4.2.

²⁶⁷ *ibid*, art 5.2

²⁶⁸ *ibid*, art 8.1–2.

²⁶⁹ *ibid*, art 16

2014) on the methods used by the Member States, and the implications, as regards the establishment of different types of targets to reduce the risks and use of pesticides.²⁷⁰ It shall also submit a report (by November 2018) on the experience gained by Member States on the implementation of national targets in order to achieve the objectives of the Directive. This may be accompanied, if necessary, by appropriate legislative proposals.²⁷¹

To sum up, the PPP Regulation and the SUD lay down procedures for knowledge generation through monitoring of both the environmental media, including human health, as well as the human pressures affecting these (the usage of pesticides). The feature of iteration is reflected in regards of the fundamental means of the Regulation. There are structures for reviewing management measures, such as time-limited approvals and authorisations with subsequent renewal procedures. Iteration is also reflected in relation to the NAPs. Without judging on the efficacy of the iteration processes (e.g., the length of the approval periods), one can conclude that the function of iteration is reflected within these instruments. Thus, these instruments meet the criteria of both ‘increasing knowledge’ and of ‘iterative management’, which contributes to their resilience and adaptive capacity.

4.6.2. Crossing Sectoral, Jurisdictional and Public/Private Boundaries

In resilience research, managing connectivity is put forward as a key principle. Connectivity refers to the way that parts of social-ecological systems interact with each other. Looking at social systems, this could, inter alia, mean the exchange of information between individuals, organisations, and governing bodies. The links between different entities could also take the form of, inter alia, trust, opinion, ideas, transfer of resources, rules, norms, and decisions.²⁷² Connectivity is often understood to be the linking of different sectors on domestic and transboundary scales. It is suggested that this shall include the involvement of the private sector in the construction and implementation of governance measures.²⁷³ Connectivity is assumed to be necessary to facilitate the flow of information needed for resilience building of social-ecological systems. The strength and structure of connectivity may affect the possibility to safeguard core functions of the systems against disturbances, by facilitating recovery or constraining the spread of disturbance.²⁷⁴ Soinen and Platjouw’s suggested

²⁷⁰ *ibid*, art 4.3

²⁷¹ *ibid*.

²⁷² Vasilis Dakos and others, ‘Principle 2 – Manage Connectivity’ in Reinette Biggs, Maja Schlüter and Michael L Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 81, 84.

²⁷³ Soinen and Platjouw (n 75) 27, with references to Pasteur (n 186) 4, and UN Water, ‘Water, Food and Energy’ <www.unwater.org/water-facts/water-food-and-energy/> accessed 10 May 2019.

²⁷⁴ Dakos and others (n 272) 83, with reference to Magnus Nyström and Carl Folke, ‘Spatial Resilience of Coral Reefs’ (2001) 4(5) *Ecosystems* 406.

criterion ‘crossing sectoral, jurisdictional and public/private boundaries’ may be understood against this background. They more specifically link this criterion to long-term planning processes, and suggest that these processes shall be closely linked to substantive regulatory goals and environmental management practices, as well as be integrated and connected across environmental media, sectors, interests, and governments.²⁷⁵

One of the reasons for generally emphasising multi-level structures within resilience theory is to create ‘ecosystem match’. This refers to adjustment of governance measures to the appropriate ecological scale and to the implementation of measures based on the prerequisites of the ecological systems.²⁷⁶ However, as Bohman concludes, multidimensional structures do not in themselves create ecosystem match, as aimed for from a resilience perspective.²⁷⁷ In this light, it becomes relevant to look into how ecosystem match, or an ecosystem perspective, is reflected in regulation. This aspect is however not explicitly part of Soininen and Platjouw’s criterion. This possibly weakens the potential of the criterion to provide insights on the capacity of the instruments at issue to appropriately acknowledge prerequisites of ecological systems, which is essential for the overall resilience of social-ecological systems.

Looking into the legal instruments, the authorisation and approval processes of the PPP Regulation take place both at the EU level and at the Member State level. As concerns active substances, safeners, and synergists, an application for approval shall be submitted to a Member State for examination.²⁷⁸ The Member State shall make an independent, objective, and transparent assessment of the application, in the light of current scientific and technical knowledge, and produce a ‘draft assessment report’ (a DAR), assessing whether it can be expected to meet the approval criteria.²⁷⁹ The DAR shall be submitted to the Commission, and a copy shall be sent to the European Food Safety Authority (EFSA), which is in charge of the risk assessment process.²⁸⁰ The DAR shall be circulated to the other Member States and made available to the public, allowing for submission of written comments.²⁸¹ Where appropriate, EFSA shall organise a consultation of experts.²⁸² EFSA shall adopt a conclusion whether the substance at issue can be expected to meet the approval criteria.²⁸³ It is then for the Commission to present a report called ‘the review report’, taking into

²⁷⁵ Soininen and Platjouw (n 75) 27, with references to Craig (n 170) 53–63, and Keesen and van Rijswick (n 186) 41.

²⁷⁶ Bohman (n 44) 250.

²⁷⁷ *ibid.*

²⁷⁸ PPP Reg, art 7.1.

²⁷⁹ *ibid.*, art 11.

²⁸⁰ *ibid.*, art 11.1–2.

²⁸¹ *ibid.*, art 12.1.

²⁸² *ibid.*, art 12.2.

²⁸³ *ibid.*, art 12.2.

account the DAR and the conclusion of the EFSA, and submit a draft Regulation to the Standing Committee on the Food Chain and Animal Health (the Committee), composed of representatives of the Member States.²⁸⁴ The Committee has three options: 1) vote a positive opinion (with a qualified majority); 2) vote a negative opinion; 3) deliver a no-opinion (when there is no majority or blocking minority). If a positive opinion is voted, the Commission shall adopt the draft Regulation. If a negative opinion is voted, the Commission can choose either to amend and resubmit its proposal or to appeal with an appeal committee. If there is a no-opinion, the Commission can decide to amend it and resubmit it to the Committee.²⁸⁵ With concern to the review of approvals, the Commission is granted review competence. It shall take into account requests from Member States.²⁸⁶ If there are indications that the approval criteria are no longer satisfied, the Member States, the EFSA, as well as the producer of the substance at issue, shall be informed and the producer is allowed to submit comments. The Commission may ask the Member States and the EFSA for opinions or assistance.²⁸⁷

Regarding the authorisation of PPPs, applications shall be made to the Member States where the producer intends to put the PPP on the market.²⁸⁸ The application is then examined by the Member State that received the application, or another Member State in the same zone.²⁸⁹ The examining Member State shall give other Member States in the same zone the opportunity to submit comments for consideration in the assessment.²⁹⁰ The assessment shall then be made available to the other Member States in the same zone.²⁹¹ On the basis of the conclusions of the assessment, the Member State examining the application shall grant or refuse an authorisation.²⁹² The Member State shall immediately inform the applicant and the Commission of its decision, and provide the technical or scientific justification for its decision.²⁹³

Leaving the PPP Regulation to look into the SUD, the NAPs shall be adopted by the Member States.²⁹⁴ In the processes of drawing up and revising NAPs, account shall be taken of the

²⁸⁴ *ibid* arts 13.1 and 79.1; Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety [2002] OJ L31/1, art 58.

²⁸⁵ Regulation (EU) No 182/2011 of the European Parliament and of the Council of 16 February 2011 laying down the rules and general principles concerning mechanisms for control by Member States of the Commission's exercise of implementing powers [2011] OJ L55/13, art 5.

²⁸⁶ PPP Reg, art 21.1.

²⁸⁷ *ibid*, art 21.1–2.

²⁸⁸ *ibid*, art 33.1.

²⁸⁹ *ibid*, art 35.

²⁹⁰ *ibid*, art 36.1.

²⁹¹ *ibid*, art 36.1.

²⁹² *ibid*, art 36.2.

²⁹³ *ibid*, art 36.3.

²⁹⁴ SUD, art 4.1.

health, social, economic, and environmental impact of the suggested measures, as well as all relevant stakeholder groups.²⁹⁵ Account shall also be taken to plans adopted under other EU legislation related to the use of pesticides. Directive 2000/60/EC (the EU Water Directive) is especially mentioned.²⁹⁶ Furthermore, the provisions on public participation laid down in article 2 of Directive 2003/35/EC shall apply to the preparation and the modification of the NAPs. These provisions include, *inter alia*, obligations to ensure early and effective opportunity to participate, to inform the public to which authority comments and questions may be submitted, and that due account shall be taken of the results of the public participation.²⁹⁷ While NAPs shall be adopted at Member State level, harmonised risk indicators shall be established at EU level by the Commission.²⁹⁸ Finally, substantial changes to NAPs shall be reported by the Member States to the Commission.²⁹⁹

To conclude, the approval process of active substances, safeners, and synergists is mostly concentrated to the EU level, while the authorisation process of PPPs, and the planning for achieving a sustainable use of pesticides, are concentrated to the Member State level. EU institutions and national authorities are however involved in both of these processes. It is also allowed for participation of other Member States than the one receiving an application for approval or authorisation. Participation of both the industry and the public is allowed with regards to the approval process of active substances, safeners, and synergists, as well as the adoption of NAPs. Moreover, in the adoption of NAPs, interests related to other sectors, as well as all stakeholder groups shall be taken into account. In other words, participation across scales, including various actors, sectors and interests, is allowed in many stages of the processes laid down in these instruments. However, such inclusion is not always ensured, e.g. by compulsory inclusion of other relevant sector authorities in the approval and authorisation processes. In essence, jurisdictional boundaries are clearly crossed in the processes of this regulatory package, while crossing of sectors and public/private boundaries are allowed for but not always ensured. In light of this, this evaluative criterion may be considered largely fulfilled, while there is room for improvement. These features, as currently laid down, contribute to adaptive and resilience capacity of these instruments. However, it is possible to improve these features to further enhance adaptive and resilience capacity.

²⁹⁵ *ibid.*

²⁹⁶ *ibid.*, art 4.5.

²⁹⁷ Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC [2003] OJ L156/17, art 2.

²⁹⁸ SUD, arts 15.1 and 15.4.

²⁹⁹ *ibid.*, art 4.2.

4.6.3. Access to Information

Another key principle for resilience building is broadened participation. This refers to the active engagement of relevant stakeholders in management and governance processes.³⁰⁰ This could mean anything from simply informing stakeholders to complete devolution of power.³⁰¹ It is assumed that involving a diversity of stakeholders will contribute to legitimacy and to promote the understanding of the systems by expanding the depth and diversity of knowledge. Moreover, it is frequently argued that legitimacy, as an expression of trust, is the basis for compliance.³⁰² In this light, Soinen and Platjouw put forward the right to ‘access to information and justice’ for stakeholders, which may be understood against the principle of broadened participation and the importance of trust-building.

With regards to public access to information under the PPP Regulation, it is laid down that the summary dossier, accompanying an application for approval of an active substance, safener, or synergist, shall without delay be made available to the public.³⁰³ The dossier shall contain scientific information and studies on the active substance at issue.³⁰⁴ It is laid down that an applicant applying for approval of an active substance, safener, or synergist, may request certain information and certain parts of the dossier to be kept confidential.³⁰⁵ A request to keep information submitted confidential shall be accompanied by evidence to show that the disclosure of the information ‘might undermine his commercial interests, or the protection of privacy and the integrity of the individual’.³⁰⁶ Certain types of information is stated to normally be deemed to undermine those interests, inter alia, methods of manufacture, results of production batches, and links between a producer or importer and the applicant or authorisation holder.³⁰⁷ However, this is without prejudice to Directive 2003/4/EC which concerns public access to environmental information.³⁰⁸ Member States shall assess the confidentiality requests, and upon a request for access to information the Member State responsible shall decide what information that shall be kept confidential.³⁰⁹

³⁰⁰ Anne M Leitch and others, ‘Principle 6 – Broaden Participation’ in Reimund Biggs, Maja Schlüter and Michael L Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015) 203, with reference to Lindsay C Stringer and others, ‘Unpacking “Participation” in the Adaptive Management of Social–ecological Systems: a Critical Review’ (2006) 11(2): 39 *Ecology and Society*.

³⁰¹ Leitch and others (n 300) 201.

³⁰² Bohman (n 44) 314, with reference to Thomas M Franck, ‘Legitimacy in the International System’ (1988) 82(4) *American Journal of International Law* 705.

³⁰³ PPP Reg, art 10.

³⁰⁴ *ibid*, art 8.

³⁰⁵ *ibid*, art 7.3.

³⁰⁶ *ibid*, art 63.1.

³⁰⁷ *ibid*, art 63.2.

³⁰⁸ *ibid*, art 63.3; Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC [2003] OJ L41/26.

³⁰⁹ PPP Reg, art 7.3.

Information which has been requested to be confidential (and such treatment is justified in accordance with the Regulation) shall be excluded unless there is ‘an overriding public interest in its disclosure’.³¹⁰ The same procedures apply in case of an application for renewal of approval of an active substance.³¹¹ The draft assessment report (see previous section 4.6.2.) shall be made available to the public after giving the applicant two weeks’ time to request that certain parts of the report should be kept confidential.³¹² After allowing for submission of comments on the draft assessment report, a conclusion shall be adopted on whether the active substance can be expected to meet the approval criteria. This conclusion shall also be made available to the public.³¹³ Finally, looking beyond the approval process, the Commission should maintain a list of approved active substances to the public electronically.³¹⁴

In regards of authorisations of PPPs, Member States shall keep information available to the public electronically on authorised or withdrawn PPPs.³¹⁵ As concerns the authorisation process, Member States shall keep and make available upon request, to any interested party, a list of the test and study reports concerning the active substance, safener, or synergist, adjuvants and the PPP, which was necessary for first authorisation, amendment of the authorisation conditions, or renewal of the authorisation. A list of test and study reports, for which the applicant claimed data protection under the Regulation, and any reasons submitted for that, shall also be kept and made available upon request, to any interested party.³¹⁶

If a PPP is identical to a product already authorised within a certain Member State, that Member State shall grant a parallel trade permit in regards of that product, allowing the holder of the permit to import and sell the PPP within that Member State.³¹⁷ Without prejudice to provisions in the Regulation granting applicants confidentiality, information about parallel trade permits shall be made available publicly.³¹⁸

Finally, one may note that third parties, such as drinking water industry, retailers, and residents, may request access to the information of the records on production, importation, exportation, storage, or placing on the market of PPPs. This also applies in regards of the records on the use of PPPs, including time and dose of application, as well as area and crop on which the PPP

³¹⁰ *ibid*, art 10.

³¹¹ *ibid*, art 16.

³¹² *ibid*, art 12.1.

³¹³ *ibid*, art 12.2.

³¹⁴ *ibid*, art 13.4.

³¹⁵ *ibid*, art 57.

³¹⁶ *ibid*, art 60.2.

³¹⁷ *ibid*, art 52.1.

³¹⁸ *ibid*, 52.11.

was used. The competent authorities shall provide access to this information in accordance with applicable national law or EU law.³¹⁹

As concerns the SUD, the Member States should make the information on their NAPs that they communicate to the Commission and other Member States available online to the public.³²⁰ Moreover, the provisions on public participation laid down in article 2 of Directive 2003/35/EC shall apply to the preparation and the modification of the NAPs. These provisions include, inter alia, obligations to ensure that the public is informed about any proposals and that relevant information about such proposals is made available.³²¹

As concerns the specific practice of aerial spraying, records shall be kept of requests and approvals to carry out aerial spraying. These, and the relevant information contained therein, such as the area to be sprayed, the provisional day and time of the spraying, and the type of pesticide, shall be made available to the public in accordance with applicable national law or EU law.³²² Moreover, Member States may include in their NAPs rules for informing persons who could be exposed to spray drift.³²³

As regards the risks and monitoring of pesticide usage at Member State level, more specifically the calculation of risk indicators, identification of trends in the use of certain active substances, and the identification of priority items, this information shall be made available to the public. The risk indicators calculated by the Commission at EU level, to estimate trends in risks arising from pesticide usage, shall also be made available online to the public.³²⁴

Finally, one may note that the Member States should take measures to inform the general public, in particular regarding the risks and potential harmful effects of pesticide usage.³²⁵ The EU legislator expresses in the introductory part of the Directive that ‘the general public should be better informed of the overall impacts of the use of pesticides through awareness-raising campaigns, information passed on through retailers and other appropriate measures’.³²⁶

To conclude, apart from acknowledging commercial interests among producers to keep certain information confidential, the public, including stakeholders, is rather well ensured access to information submitted under the PPP Regulation, as well as information concerning the NAPs of the SUD. Arguably, this evaluative criterion should be considered fulfilled. Ensuring stakeholders

³¹⁹ *ibid*, art 67.1.

³²⁰ SUD, art 4.4.

³²¹ Dir 2003/35/EC, art 2.

³²² SUD, art 9.6.

³²³ *ibid*, art 10.

³²⁴ *ibid*, art 15.4.

³²⁵ *ibid*, art 7.1.

³²⁶ *ibid*, recital 10.

access to information in this way is assumed to contribute to the adaptive and resilience capacity of these instruments.

4.6.4. Access to Justice

Looking into the aspect of access to justice for stakeholders, one should initially note that the CJEU is granted competence to review the legality of legislative acts by the Commission, including approvals or non-approvals of active substances, safeners, and synergists.³²⁷ In the Treaties, it is laid down that

any natural or legal person may institute proceedings against an act addressed to that person or which is of direct and individual concern to them, and against a regulatory act which is of direct concern to them and does not entail implementing measures.³²⁸

As concerns the approval of active substances, this has been interpreted several times by the Courts of the European Union, to mean that

a notifier of an active substance, having submitted the dossier and participated in the assessment procedure, is individually concerned as much by a measure authorising the active substance subject to conditions as by a measure refusing authorisation.³²⁹

It was recently laid down that ‘the same analysis must be considered to apply in principle where the measure in question withdraws or restricts the approval of the active substance’.³³⁰ As concerns the standing of other producers of a substance at issue, other than the notifier, the possibility of access to justice appears more limited. In a recent judgement, action was brought by an association of producers of copper compounds against a Regulation that included copper compounds on the list of

³²⁷ TFEU, art 263.

³²⁸ *ibid.*

³²⁹ Cases T-429/13 and T-451/13 *Bayer CropScience AG and Others v European Commission* [2018] ECLI:EU:T:2018:280, para 70, with references to Cases T-326/07 *Cheminova and Others v Commission* [2009] ECLI:EU:T:2009:299, para 66, and T-420/05 *Vischim v Commission* [2009] ECLI:EU:T:2009:391, para 72, and T-483/11 *Sepra Europe v Commission* [2013] ECLI:EU:T:2013:407, para 30.

³³⁰ Case T-584/13 *BASF Agro BV and Others v European Commission* [2018] ECLI:EU:T:2018:279, para 45.

candidates for substitution.³³¹ The members of this association were considered to be concerned by the Regulation at issue

only in their objective capacity as producers of copper compounds, and thus in the same capacity as any other economic operator actually or potentially in an identical situation, and that they were not therefore individually concerned by the regulation at issue.³³²

Their appeal was hence considered inadmissible.³³³ One may note that individual parties, wishing to review EU legislation have an additional option by indirect judicial review. This means that judicial review can be brought as part of a preliminary ruling procedure under article 267 on any Union act, on any grounds, and by anyone, i.e. there are no requirements of direct and individual concern.³³⁴ Nevertheless, there are limitations set by the preliminary ruling procedure. Individuals have no ‘right’ to demand indirect review if a national court considers it clear that the act at issue is valid.³³⁵ The situation is rather different for Member States, the European Parliament, the Council, and the Commission. They always have the right to initiate a judicial review of legislative acts, including approvals or non-approvals of active substances, safeners, or synergists.³³⁶

As concerns that authorisation of PPPs, Member States are obligated to provide for the possibility to challenge, before national courts or other instances of appeal, a decision to refuse the authorisation of a PPP.³³⁷

As concerns access to justice in relation to the right to access to information, no specific provisions are laid down neither in the PPP Regulation, nor in the SUD. However, it is laid down in the PPP Regulation that the provisions laid down therein, making it possible to keep information submitted under the Regulation confidential, applies without prejudice to Directive 2003/4/EC, which concerns public access to environmental information.³³⁸ This Directive obligates Member States to ensure access to justice for applicants requesting information.³³⁹

³³¹ Case C-384/16 P *European Union Copper Task Force v European Commission* [2018] ECLI:EU:C:2018:176.

³³² *ibid*, para 97.

³³³ *ibid*, para 122.

³³⁴ TFEU, art 267.

³³⁵ Schütze (n 78) 365.

³³⁶ TFEU, art 263.

³³⁷ PPP Reg, art 36.3.

³³⁸ PPP Reg, art 63.3; Dir 2003/4/EC.

³³⁹ Dir 2003/4/EC, art 4.

To conclude, access to justice for certain stakeholders, namely applicants for approval of an active substance, safener, or synergist, or applicants for authorisation of a PPP, are ensured through these instruments or within the wider legal structure of the Union. This includes access to justice for Member States and several EU institutions. However, the group of stakeholders with interests in agricultural pesticide usage may be considered wider than that. This includes, inter alia, the chemical industries, the agricultural industries (including farmers), as well as public interest groups (e.g. groups working for environmental protection and consumer protection).³⁴⁰ In this light, stakeholders' access to justice in relation to management measures under these instruments may be considered as limited. Access to justice is however more widely granted in relation to access of information. Nevertheless, due to limited access to justice in relation to the main means of the PPP and the SUD, this criterion is arguably not fulfilled. This lack of access to justice is assumed to obstruct the adaptive and resilience capacity of these legal instruments.

4.7. Instrument Choice

4.7.1. *Direct Regulation Coupled with other Policy Instruments*

Diversity is generally put forward as a key principle for building resilience in social-ecological systems (see above section 4.5.1).³⁴¹ The suggestion that direct legal regulation should be coupled with other types of policy instruments may be understood against this background. Direct legal regulation may be defined as directly applicable rules of conduct. These are sometimes referred to as 'command and control'-rules, since they concern how humans should act, i.e. they contain a kind of 'command'.³⁴² A characteristic of 'command and control' is that 'very little, if anything, is left for the addressee of the law to variate'.³⁴³ From the resilience perspective, other types of policy instruments are deemed as crucial complements to direct legal regulation, in particular economic instruments – but also purely voluntary instruments, such as measurements for spreading of information. The rationale behind this call is that a diverse mix of policy instruments may foster innovative responses to changes and pressures within social-ecological systems.³⁴⁴

Since having the form of a Regulation, the PPP Regulation is binding in its entirety and directly applicable in all Member States.³⁴⁵ It prescribes whether, when, and how the authorisation of PPPs shall be carried out. It also lays down prescriptions on the use and control of PPPs. Thus, it

³⁴⁰ Bozzini (n 1) 47.

³⁴¹ Kotschy and others (n 214).

³⁴² Westerlund (n 51) 9, 29.

³⁴³ *ibid* 32.

³⁴⁴ Arnold and Gunderson (n 162) 10432–10436.

³⁴⁵ Craig and De Búrca (n 90) 107.

represents a typical ‘command and control’-approach, and consequently has the character of direct legal regulation. The stated reason for choosing this type of instrument is ‘to simplify application of the new act and to ensure consistency throughout the Member States’.³⁴⁶

As concerns other types of policy instruments, it is stated in the recitals of the Regulation, that the Council

should include in the statutory management requirement referred to in Annex III to Council Regulation (EC) No 1782/2003 (...) the principles of integrated pest management, including good plant protection practice and non-chemical methods of plant protection and pest and crop management.³⁴⁷

Council Regulation (EC) No 1782/2003 is no longer in force. Currently, the same matters, namely direct EU payments to farmers, are regulated by Regulation (EU) No 1307/2013.³⁴⁸ This seems to be an effort by the EU legislator to link the means, laid down in the PPP Regulation, to economic incitements. Besides this statement, the PPP Regulation does not provide, promote, or address any complementary policy instruments, apart from those laid down in the SUD.

The SUD differ in character from the PPP Regulation. Directives are generally binding only to the ends to be achieved, while leaving discretion to the Member States to choose form and method on how to achieve these ends.³⁴⁹ In the recitals of the SUD, complementary policy measures are generally acknowledged in the governing of pesticide usage.

Economic instruments can play a crucial role in the achievement of objectives relating to the sustainable use of pesticides. The use of such instruments at the appropriate level should therefore be encouraged while stressing that individual Member States can decide on their use without prejudice to the applicability of the State aid rules.³⁵⁰

³⁴⁶ PPP Reg, recital 5.

³⁴⁷ *ibid*, recital 35.

³⁴⁸ Regulation (EU) No 1307/2013 of the European Parliament and of the Council of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009 [2013] OJ L347/608.

³⁴⁹ Craig and De Búrca (n 90) 108.

³⁵⁰ SUD, recital 4.

Moreover, it is stated in the recitals that measures of the SUD ‘should not prejudice voluntary measures in the context of Regulations for Structural Funds or of Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)’.³⁵¹

To conclude, looking at this regulatory package as a whole, direct legal regulation is combined with an instrument that leaves management discretion to the Member State level. Direct legal regulation is used as the main policy instrument in regards of the authorisation of sale, use, and control of PPPs. In relation to achieving sustainable use, the SUD obligates Member States to take certain measures, in order to achieve certain ends, but the exact content and forms of these measures are left to the Member States to decide. Economic policy instruments are explicitly encouraged, but not directly coupled with neither the PPP Regulation, nor the SUD. With the SUD, the EU legislator to some extent goes beyond direct legal regulation. Nevertheless, these two instruments do arguably not make up a diverse mix of policy instruments. Since they are not coupled with economic or other voluntary policy instruments, the evaluative criterion at issue cannot be considered fulfilled. Due to this, potentially innovative responses to changes and pressures within social-ecological systems, related to agricultural pesticide usage, may be obstructed or hindered.

4.8. Enforcement

The last three criteria concerning enforcement are conjunctively dealt with in this, and subsequent, sections. Social-ecological systems comprise of, and are affected by, a number of variables that change and interact on a range of timescales: slower or faster. Slow variables change much more gradually: this could be soil composition, social values, or legal systems; in comparison with faster variables, such a methods of crop production or allocation of financial resources.³⁵² Feedback is when change in a particular variable of a social-ecological system leads to changes in the system, and that these changes eventually loop back, affecting the original variable.³⁵³ The importance of managing especially slow variables and feedbacks is within resilience research put forward as a key principle for resilience building. Otherwise, certain thresholds may be crossed and a system may shift from one regime to another, which are often associated with large, rapid changes of ecological systems, which in turn could have immense impact on social systems.

³⁵¹ *ibid*, recital 3.

³⁵² Reinette Biggs and others, ‘Principle 3 – Manage slow variables and feedbacks’ in Reinette Biggs, Maja Schlüter and Michael L Schoon (eds), *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (Cambridge University Press 2015), 109.

³⁵³ *ibid*.

In light of this, the control and management of slow variables and feedbacks is considered essential for contributing to the capacity to maintain desired functions of social-ecological systems, restore social-ecological systems to more desired states, or transform them to entirely new states.³⁵⁴ Moreover, sanctioning systems, intended to ensure compliance by all actors, is considered vital for trust-building, which from a resilience perspective is important for institutional stability and continuity in management.³⁵⁵ The criteria by Soininen and Platjouw of legally binding and specific obligations to achieve goals, time limits of these goals, and sanctioning of non-compliance, may all be understood against this perspective of social-ecological resilience theory.

4.8.1. Legally Binding and Specific Obligations to Achieve Goals

Since having the form of a regulation, the PPP Regulation is binding in its entirety and directly applicable in all Member States.³⁵⁶ Detailed rules on the authorisation, use, and control of PPPs are laid down in order to achieve the goals of the Regulation. As concerns the SUD, since having the form of a Directive, it is binding only as to the results to be achieved, and only upon the Member States to which it is addressed.³⁵⁷ This Directive is addressed to the Member States, thus it is binding upon all the Member States.³⁵⁸ It contains specific obligations to adopt NAPs, including obligations on what shall be included in these.³⁵⁹

4.8.2. Time Limits for Goals

The goals of the PPP Regulation are not coupled with any time limits. The substantive goal of the SUD, achieving sustainable use of pesticides, also lacks time limit. However, an initial deadline for the procedural goal of adopting NAPs is laid down. The NAPs shall be communicated no later than 26 November 2012.³⁶⁰ In addition, several of the specific obligations related to the NAP have time limits for when to be achieved, including training; requirements for sales of pesticides; information and awareness-raising; inspection of equipment in use; integrated pest management; and penalties.³⁶¹

³⁵⁴ *ibid* 105.

³⁵⁵ Bohman (n 44) 314, with reference to Franck (n 302).

³⁵⁶ TFEU, art 288.

³⁵⁷ *ibid*.

³⁵⁸ SUD, art 25.

³⁵⁹ *ibid*, arts 4–15.

³⁶⁰ *ibid*, art 4.2.

³⁶¹ *ibid*, arts 5, 6, 7, 8, 14 and 17.

4.8.3. Sanctioning of Non-Compliance

Looking into the aspect of sanctioning of non-compliance, Member States are obligated to lay down penalties applicable to infringements of the PPP Regulation. The Member States are obligated to take all measures necessary to ensure that the penalties are implemented. The penalties shall be ‘effective, proportionate and dissuasive’.³⁶² A corresponding obligation is laid down in the SUD, obligating Member States to determine penalties applicable to infringements of national provisions adopted pursuant to the SUD. Also in regards of the SUD, the Member States are obligated to take all measures necessary to ensure that the penalties are implemented, and that the penalties are ‘effective, proportionate and dissuasive’.³⁶³ Finally, if a Member State breaches the PPP Regulation, or fails to fulfil the obligations of the SUD, the Member State at issue may be brought before the CJEU either by the Commission or by another Member State.³⁶⁴ In the scenario where a Member State fails to comply with a judgement of the CJEU, financial sanctions may be imposed, if the Commission applies for such penalties.³⁶⁵

4.8.4. Enforcement Criteria – Summary

To sum up, these legal instruments contain binding and specific obligations in order to achieve the goals set out. The substantive goals, however, lack time limits. As concerns the procedural goals, the means of the PPP Regulation are directly applicable, leaving no room for delay in implementation. The procedural goal of the SUD is coupled with a certain deadline, and many of the procedural goals of the SUD have time limits. Sanctioning of non-compliance is also included. Thus, two of these criteria, binding and specific obligations, and sanctioning of non-compliance, is to be considered fulfilled. The inclusion of these aspects in this regulatory package is assumed to contribute to adaptive and resilience capacity of these instruments. The second criterion of time limits is only partly met, leaving room for improvements that could further enhance adaptive and resilience capacity.

³⁶² PPP Reg, art 72

³⁶³ SUD, art 17.

³⁶⁴ TFEU, arts 258–259.

³⁶⁵ TFEU, art 260.

5. CONCLUSIONS

In the light of the previous review of social-ecological resilience theory and analysis of EU pesticides law, this section aims to address and answer the chosen research questions. Broadly, social-ecological resilience theory may provide guidance on how to make EU pesticides law capable of handling the dynamics of social-ecological systems. This theory may be a tool for including features, within EU pesticides law, that contribute to resilience building within social-ecological systems. While adaptive capacity, contributing to social-ecological resilience, is already rather well reflected in the PPP Regulation and the SUD, it is possible to further enhance this capacity. Moreover, additional perspectives and concepts may be required to ensure that pesticide usage does not contribute to transgression of ‘planetary boundaries’.

5.1. Social-Ecological Resilience Theory as a Tool for Addressing Regulatory Challenges

The first research question of this thesis concerns how social-ecological resilience theory can inform the making of EU pesticides law. Within research, it is suggested that social-ecological resilience theory can serve as a tool for managing the interactions of social and ecological dynamics, such as those of agricultural production and ecosystems, so that the social-ecological systems can maintain core functions and continue developing. In the field at hand this could mean maintaining or even increasing capacity to provide food security for the current human population, whilst not ruining the prerequisites necessary for providing food security for future generations. More specifically, social-ecological resilience theory is focused on making social-ecological systems capable of coping with aspects such as change, pressure, shock, uncertainty, and complexity. These characteristics are significant for the phenomenon of pesticide usage. For example, there has been no linear progression in the scientific field of toxicology, but a back and forth of contradictions and disagreement. Many ‘unexpected’ effects of chemicals continue to be discovered, such as harmful effects by pesticides on non-target animals, which are often followed by discussions on the issue of causality. These characteristics can be expected to pose challenges to the governance of agricultural pesticide usage, including the making of laws. Traditionally, legal systems and legal structures have been struggling to deal with these facets. Nevertheless, the law influences the capacity of social-ecological systems to cope with challenges stemming from the interactions of social and ecological dynamics. Accordingly, EU pesticides law influence the capacity to maintain core functions of social-ecological systems, of which many are essential for human well-being. This includes, inter alia, the ability to provide food security and maintain ecosystem services. The aims of social-ecological resilience theory include handling impartial or incomplete knowledge, such as that of the impacts of pesticide usage on

ecological systems, and the consequences of this lack of knowledge. In this light, social-ecological resilience theory can be used as a tool to address and handle these challenges mentioned in the making of EU pesticides law.

Pesticide usage is a complex issue which includes many different dimensions and interests. For example, agricultural production needs to increase over the years in order to provide food security for the human population. Without utilisation of pesticides, it is estimated that food production will decrease significantly and that food security will be at risk. At the same time, pesticide usage may ruin the natural prerequisites of agricultural production, which will also, *inter alia*, jeopardise food security. The tension between food security and protecting the environment and human health is at the centre of pesticide regulation. In EU pesticide regulation also the aims of establishing a functioning EU internal market, and a competitive EU agricultural sector, are included. Social-ecological resilience theory may be used as a theoretical tool to make laws that can handle and ensure an informed balancing of this plurality of purposes. Instead of e.g. promoting ecological primacy in every situation, social-ecological resilience theory may be considered as an attempt to provide tools for balancing human activities of agriculture, such as pesticide usage, with the behaviour of ecological systems. This includes, *inter alia*, establishing structures for learning and increased knowledge, in order to identify critical thresholds of the systems, and thus making it possible to avoid these thresholds. In the field of agricultural pesticide usage this may be, e.g., in the form of laws ensuring close monitoring of the environment and the effects of pesticides, as well as laws providing tools for quickly responding to unexpected effects of pesticides.

From the perspective of ‘planetary boundaries’, there are ecological thresholds that should not be transgressed if not to put the possibility for human well-being at risk. With great attention to critical thresholds, and the ability to continue developing, social-ecological resilience theory is relevant from a ‘planetary boundary’ perspective. However, while providing tools that may be essential for governing pesticide usage in such a way that ‘planetary boundaries’ are not transgressed, this theory lacks substantial concepts for guaranteeing that these thresholds actually are acknowledged. For example, features such as flexibility, knowledge, participation, and enforcement may be necessary features of governance, and the law, in order to avoid critical thresholds. However, these features do not per se ensure that the goals that are chosen within the regulatory field of agricultural pesticide usage, and subsequent governance measures, do not contribute to transgression of ‘planetary boundaries’. Trade-offs between interests will inevitably be influenced by distribution of power among actors and between different preferences. Power differences could occur between different interests, such as, on the one hand, preferences for preserving biodiversity and ecosystem services, and, on the other hand, preferences for extensive utilisation of chemicals in agricultural

production and maximisation of crop-yields. Power differences could also occur between current and future generations, as concerns their ability to defend their interests. Social-ecological resilience is promoted as a theory that takes social aspects into account. Nevertheless, it generally lacks attention to the issue of power, even though power influences the trade-offs inherent in the governing of social-ecological systems. Acknowledging this aspect may be critical to keep human activities, including pesticide usage, within ecological thresholds. These perspectives on the issue of power is relevant in relation to political decision-making but also in relation to the law. There is a lack of attention to power also within adaptive law theory. Adaptive capacity of the law is likely to be necessary to adjust human behaviour to stay within ecological thresholds. At the same time, adaptive capacity may provide adaptivity that favours the preference of environmental protection as well as the preference of environmental exploitation. From a ‘planetary boundary’ perspective, it is thus necessary to critically assess the effects of adaptive law features, as well as the effects of letting the principles of social-ecological resilience theory inform the law.

To conclude, social-ecological resilience theory may provide guidance on how to make EU pesticides law in such a way that the law does not obstruct but makes it possible to handle challenges of change, shock, pressure, uncertainty, and complexity related to pesticide usage. This theory may also provide guidance on how to establish legal structures that ensure an informed balancing of the different aims of EU pesticides law. However, the mean of letting social-ecological resilience theory inform EU pesticides law may not in itself be sufficient to ensure that ‘planetary boundaries’ are not crossed. Social-ecological resilience can provide essential guidance on how to include features that are necessary for building resilience capacity – including ability to avoid transgression of ecological thresholds. Nevertheless, further theoretical perspectives, inter alia with attention to issues of power, are likely to be necessary to guarantee that such critical boundaries are not transgressed.

5.2. Features for Social-Ecological Resilience Reflected within the Law

The second research question concerns whether adaptive capacity, contributing to social-ecological resilience, is reflected within EU pesticides law, and if so, how this is reflected. The third research question concerns whether the adaptive capacity of EU pesticides law, contributing to social-ecological resilience, can be increased, and if so, in what aspects. In this subsection, these questions will be addressed in conjunction.

Adaptive law theory constitutes the specific framework for this analysis of EU pesticides law. Besides informing how to address challenges such as change, shock, pressure, uncertainty, and complexity, adaptive law theory addresses traditional normative ends within legal

systems, related to rule of law and legal certainty. These functions are a delicate matter from a resilience perspective, since they may both hamper resilience capacity, as well as be necessary to ensure such capacity. In this light, the evaluative criteria employed in this analysis suggest adaptive capacity in two directions. Firstly, the law should have adaptive capacity in relation to dynamics ‘external’ to the law, such as behaviour of ecosystems. Secondly, the law should have the capacity to ensure adaptation of social behaviour, such as pesticide application, in relation to legal requirements and governance measures. The result of the evaluation of the PPP Regulation and the SUD against these criteria indicates that these instruments have a rather good adaptive capacity. Out of 10 evaluative criteria, 6 are fulfilled, and 3 are partly fulfilled, while 1 criterion is not fulfilled.

As concerns substance, these instruments meet the criteria of plurality of goals, or goals of diverse character, and that of discretion to adjust management in the light of new scientific understanding. In the wider perspective, these criteria, *inter alia*, contribute to features such as diversity and encouragement of learning. These features are considered essential for resilience building within social-ecological systems, by addressing the incomplete knowledge of these systems, as well as providing tools for adaptation. Nevertheless, it is possible to increase the adaptive capacity in relation to the first criterion, since the goals may be considered to lack clarity. Adjusting this aspect can make it easier to enforce these goals as well as to review the legality of governance measures. Such an adjustment will contribute to the capacity to manage slow variables and feedbacks, which is considered as an important feature of resilience building within social-ecological systems.

As concerns the procedures of the PPP Regulation and the SUD, they meet the criteria of increasing knowledge and iteration of processes. In the broader perspective, these features contribute to resilience building, *inter alia*, by addressing the incomplete knowledge of social-ecological systems through encouraging learning. The criterion of crossing sectoral, jurisdictional and public/private boundaries are largely met, allowing for connectivity across scales and sectors, which is assumed to contribute to the resilience of the social-ecological systems. However, while such participation is allowed for, it is not always ensured. By guaranteeing inclusion, *inter alia*, by perspectives from other sectors, this aspect could be enhanced and thus further contribute to resilience capacity. The criterion of access to information and justice are partly met. Access to information can be considered ensured, while access to justice are ensured only certain stakeholders. In this light, the criterion should not be considered fulfilled. Widening access to justice, and granting this to a broader range of stakeholders, will likely enhance the resilience features of both broadened participation and connectivity. Such an adjustment is also likely to increase legitimacy of governance measures among actors, which is assumed to further compliance with these measures, enhancing the resilience feature of managing slow variables and feedbacks.

In regards of instrument choice, the criterion of coupling direct regulation with economic and voluntary instruments is not met. By complementing direct regulations and using a more diverse mix of policy instruments the feature of diversity within this regulatory field will be enhanced. Such an adjustment will provide more options for response and adaptation to change, pressures, and shocks within the social-ecological systems at issue, and thus contribute to their resilience capacity.

As concerns enforcement, the criteria of legally binding and specific obligations to achieve procedural and substantive goals, and sanctioning of non-compliance can be considered to be met. This is likely to enhance, *inter alia*, the resilience feature of managing slow variables and feedbacks. However, the criterion of time limits for goals is only partly met, since there are only time limits in regards of procedural goals. Including time limits also in regards of substantive goals, will likely enhance the capacity to manage slow variables and feedbacks within these social-ecological systems, contributing to their resilience capacity.

To sum up, adaptive capacity is reflected within the PPP Regulation and the SUD in regards of substantive goals, management adjustment in the light of new scientific understanding, increasing knowledge, iteration, access to information, obligations to achieve procedural and substantive goals, and sanctioning of non-compliance. These aspects, put forward within adaptive law theory, contribute to features, such as diversity, encouraging learning, broadened participation, and management of slow variables and feedbacks, which are considered key elements in resilience building within social-ecological systems. Adaptive capacity is however not reflected in regards to instrument choice and access to justice, and only partly reflected as concerns crossing sectoral, jurisdictional and public/private boundaries, as well as time limits for goals. In regards to these aspects, it is possible to improve EU pesticides law to further contribute to features essential for resilience building, *inter alia*, connectivity, broadened participation (including legitimacy), and the management of slow variables and feedbacks.

The contribution of adaptive capacity (as interpreted within the chosen evaluative criteria) to social-ecological resilience is largely reflected in the PPP Regulation and the SUD. This implies that the EU laws governing agricultural pesticide usage contributes to the capacity to address and handle change, pressure, shock, uncertainty, and complexity, relating to the phenomenon of pesticide usage. This also indicates that these legal instruments can help balance the behaviour of social systems, such as pesticide application, with the behaviour of ecological systems, such as changes within ecosystems. This also implies the capacity to identify critical thresholds within the ecological systems, *ergo* enabling governance measures and decisions that adjust human activities so that they do not cross system boundaries. In this light, the PPP Regulation and the SUD have the

potential to contribute to the avoidance of transgressing ‘planetary boundaries’, such as the one related to chemical pollution. Since there is room for improvements of the adaptive and resilience capacity of these instruments in certain aspects, this regulatory package should perhaps not be considered a role model for the making of laws having adaptive and resilience capacity. Nevertheless, these instruments may serve as valuable references in such processes.

This analysis and exploration of ways to improve EU pesticides law is largely theoretical. While adaptive and resilience capacity of these legal instruments is rather well reflected *de jure*, further analysis of more empirical character is needed to provide knowledge of how, and in what ways, these instruments *de facto* contribute (or not contribute) to the resilience of social-ecological systems. This may also shed further light on how features of adaptive law, in a broader perspective, contribute (or not contribute) to the resilience of social-ecological systems.

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