Resilience and Adaptivity of EU Pesticides Law – Assessing Theory and Legal Capacity

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Abstract

The utilisation of pesticides in 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 article explores how the regulatory challenge this poses may be handled and potential ways of improving EU pesticides law from the perspective of 'planetary boundaries'. More specifically, it investigates in which 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. Regulation 1107/2009 and Directive 2009/128/EC are evaluated against a set of adaptive law criteria measuring the adaptive and resilience capacity of regulatory instruments.

It is concluded that adaptive capacity, contributing to social-ecological resilience, is currently largely well reflected within these instruments. Hence, EU pesticides law may serve as a reference for the making of laws having adaptive and resilience capacity. Certain features of these instruments, however, could be improved. In that regard, social-ecological resilience theory can provide guidance on how to make EU pesticides law capable of handling regulatory challenges, significant for pesticide usage. This theory may be a tool both for establishing legal structures that enhance an informed balancing of different regulatory aims and for including functions within EU pesticides law that are necessary for building resilience within social-ecological systems. This includes the ability to avoid the transgression of ecological thresholds. However, additional theoretical concepts and tools are 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

1. Introduction

Pesticide use is standard practice in today's farming.[1] The main function of pesticides in agricultural production is to guarantee food security. The concept of food security is defined as the condition where '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'.[2] The potential benefits of pesticides are, *inter alia*, decreased food losses, elimination of pathogens, and reduced labour and energy use.[3] If the utilisation of chemical pesticides ceased it is estimated that

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[1] European Environment Agency, 'Pesticide Sales' (29 November 2018) <www.eea.europa.eu/airs/2018/environment-and-health/pesticides-sales> accessed 13 October 2019.

[2] David A Bender, 'Food Security', *A Dictionary of Food and Nutrition* (4 edn, Oxford University Press 2014).

[3] Emanuela Bozzini, *Pesticide Policy and Politics in the European Union: Regulatory Assessment, Implementation and*

between 25% and 40% of the world food supply could be lost each year, seriously jeopardising food security.[4] Moreover, pesticides may reduce the cost of food production, making food more affordable for people that currently suffer from starvation.[5]

Looking ahead, it is believed that agricultural production will have to increase by 75% in the years to come in order to sustain the growing human population of the world.[6] In light of this, it is argued that pesticides based on all available technologies must be utilised in order to achieve food security.[7] This view is questioned by a variety of actors: from activists to institutions. Their counterarguments contend that intensive farming methods, with extensive use of pesticides, are unsustainable. In the long term there is a risk that these methods 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 they are exposed to; in other words, the efficiency of pesticides falls the more they are used, causing a need for increased pesticide usage.[8] 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.[9]

Looking into the development of toxicology (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'.[10] The history of the field is instead characterised by contradictions and contrasts between competing paradigms, which have been described as 'a back and forth of forgetting, remembering, contest and disagreement'.[11] Nevertheless, nowadays there is a general awareness of the potential harms of pesticides among scientists, regulators and citizens. With regards to human health concerns, even though the exposure is low pesticides are thought to cause illness to individuals 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 the many health issues that may occur.[12] From an environmental perspective pesticides pose a range of risks to individual species and whole ecological systems. The 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

Enforcement (Cham: Springer International Publishing 2017) 8, 21.

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

5 Ibid. 9.

6 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 13 October 2019.

7 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.

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

9 Bozzini (n 3) 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.

10 Bozzini (n 3) 13.

11 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.

12 Bozzini (n 3) 12.

long time after initial application as they spread through ecosystems. This may lead to, *inter alia*, pollution of soil and groundwater.[13] Over time, more and more 'unexpected' effects of chemicals have been discovered, followed by controversies surrounding the issue of causality in complex ecosystems.[14] One example of this is neonicotinoids, a class of pesticides that were introduced in the 1980s. They are now deemed a possible cause for the decline of honeybee and bumble bee populations observed in Europe and the U.S. since the early 2000s.[15]

The tension between achieving food security and protecting the environment and human health is at the centre of pesticide policy and politics. This conflict is reflected in every regulatory regime on the matter.[16] Within the European Union (EU), regulatory action on agricultural pesticide usage was taken in the early 1990s. This may be understood by 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 citizens and governments.[17] Current EU legislation on the matter was adopted in 2009 and establishes rules on both the pre- and post-market phases of pesticide usage.[18] From a global perspective EU pesticide regulation may be considered comparatively strict. During the last few decades, hundreds of chemicals that are in normal use in other parts of the world have been removed from the EU market.[19]

2. Exploring Potential Ways to Improve EU Pesticides Law

2.1 Framing The 'External' Issue

This article takes its point of departure from 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. In this area of research nine 'planetary boundaries' within which it is expected that humanity can 'operate safely' are identified. Transgressing one or more of these boundaries may be 'deleterious or even catastrophic for human well-being'.[20] It is suggested that non-linear and abrupt change on a planetary level could be triggered.[21]

The large number of chemicals that are used commercially in agricultural production cause countless adverse effects to species and ecosystems. It was recently concluded that 40% of the world's insect species are threatened with extinction and pesticide usage was identified as one of the reasons for this.[22] It has been concluded that chemical pollution stresses ecosystems and human health to the extent that the 'safe operat-

[13] 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).

[14] Bozzini (n 3) 11–13; Martin Enserink and others, 'The Pesticide Paradox' (2013) 341(6147) Science 728, 728.

[15] Bozzini (n 3) 77–78.

[16] Ibid. 2.

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

[18] 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).

[19] Bozzini (n 3) 19, 21.

[20] Johan Rockström and others, 'Planetary Boundaries: Exploring the Safe Operating Space for Humanity' (2009) 14(2): 32 Ecology and Society.

[21] Ibid.

[22] Francisco Sánchez-Bayo and Kris A G Wyckhuys, 'Worldwide Decline of the Entomofauna: A review of its drivers' (2019) 232 Biological Conservation 8, 8.

ing space' of the 'planetary boundary' of chemical pollution is being transgressed.[23] It must be noted, however, that properly relating pesticide usage to the concept of 'planetary boundaries' is complicated. An activity may pose pressure in relation to several boundaries at the same time. Interactions between pressures, related to different boundaries, may also change the safe level of one or more boundaries.[24] For example, chemical pollution may influence the biodiversity boundary by reducing the abundance of species and potentially increasing the vulnerability of species to other pressures such as climate change.[25]

2.2 The Choice of Theory: Social-Ecological Resilience

The aim of this article is to explore potential ways of improving EU pesticides law using the perspective provided by the concept of 'planetary boundaries', which suggests the choice of social-ecological resilience as a theoretical framework. 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. Social-ecological resilience theory intends to understand and address the challenges stemming from the interaction of social and ecological dynamics. This theory provides, *inter alia*, a theoretical framework for research on environmental governance providing an interdisciplinary perspective.[26] As a theoretical framework, social-ecological resilience aims to be a tool for ensuring human well-being in the face of the rapid changes, complexity, and inherent uncertainties which are perceived to characterise the world of today.[27] These characteristics are also significant for issues related to agricultural pesticide usage.[28] However, the law often struggles to deal with them.[29] One of the suggestions within law and resilience research is that, in the light of social-ecological resilience theory, the law should be adaptive. 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 have been suggested.[30] Therefore, adaptive law theory has been chosen here as the specific framework for evaluating EU pesticides law.

2.3 Defining the Research Questions

The aim of this article is not to determine what the law ought to be, but to explore ways in which the law may be improved. Hence, the first

[23] ML Diamond and others, 'Exploring the Planetary Boundary for Chemical Pollution' (2015) 78 Environ Int 8, 8.

[24] Rockström and others (n 20).

[25] Ibid, with references to Bjørn Munro Jenssen, '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.

[26] Social-ecological resilience theory is presented and addressed in detail below in section 3.

[27] 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.

[28] See above section 1.

[29] Brita Bohman, *Transboundary Law for Social-Ecological Resilience? A Study on Eutrophication in the Baltic Sea Area* (Department of Law, Stockholm University 2017) 26; Staffan Westerlund, *Fundamentals of Environmental Law Methodology* (Uppsala University, Department of Law 2007) 156 ff.

[30] See below section 4.3.

research question will investigate the potential function of social-ecological resilience as a theoretical framework guiding this regulatory field. The first research question is:

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

Furthermore, the 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 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?

Since the focus is on the phenomenon of pesticide usage in agricultural production, the substantial scope of this article will be the regulation of pesticides used for plant protection. Consequently, the main research objects 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).[31] 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' are relevant with regard to issues related to pesticides but not directly related to the activity of pesticide application in agriculture. They are therefore excluded from the scope of this article.[32] If relevant for evaluating the functioning of the PPP Regulation and the SUD, the research object will be extended beyond these instruments and also include the EU Treaties and other EU secondary law.

2.4 'Internal' and 'External' Law Methodology

The first research question is answered by a review of the literature addressing social-ecological resilience theory from both a general viewpoint and in the specific context of the law. With regards to the second and third research questions, a methodology based on both an 'external' and an 'internal' perspective on the law 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.[33] 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 certain legal sources and certain methods used for legal interpretation. Three 'classical' methods of interpretation are prominent

[31] PPP Reg; SUD.

[32] 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.

[33] Niko Soininen 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) 30.

within the EU legal order – literal, systematic, and teleological methods.[34] The interpretation of the law at hand will take its point of departure from a literal interpretation, namely by looking at the written text of legal provisions and finding meaning through the usual (contemporary) meaning of the words.[35] Besides literal interpretation, systematic and teleological interpretations will also be employed, especially if the wording is not clear and precise.[36] Through 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 the creates conflict between the specific provision and the context of which it is part.[37] 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.[38] For an appropriate interpretation of EU law, these three methods should not be considered or applied in isolation, but instead should 'operate in a mutually reinforcing manner'.[39]

3. Setting the Theoretical Frame

3.1 Viewing the World as Social-Ecological Systems

Social-ecological resilience theory comes with a fundamental assumption of the relationship between humans and nature. Within this theory, human society is viewed as part of the biosphere.[40] 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.[41] An example of this is that farming affects and shapes ecosystems, habitats and landscapes both locally and globally. At the same time, the ability to produce food is dependent on ecosystem services[42] such as pollination and the storage and cycling of water, nutrients and carbon.[43] The notion of human society as an inherent part of the biosphere means the world can be understood as a social-ecological system.[44] Systems can be natural, such as ecosystems, or man-made, such as monetary systems.[45] 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

[34] 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.
[35] Ibid. 8.
[36] Ibid. 59.
[37] Ibid. 16–17.
[38] Robert Schütze, *European Union Law* (Cambridge University Press 2015) 207.
[39] Koen and José (n 34) 61.

[40] 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).
[41] Biggs, Schlüter and Schoon (n 27) 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.
[42] 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).
[43] 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.
[44] Biggs, Schlüter and Schoon (n 27) 1.
[45] Shelley Ross Saxer and Jonathan D. Rosenbloom, *Social-Ecological Resilience and Sustainability* (Wolters Kluwer 2018) 3.

are not seen as simply social plus ecological systems, but as cohesive social-ecological systems.[46]

Research suggests that social-ecological systems are characterised by strong interactions and feedback between social and ecological dynamics, which determine the overall dynamics of the systems.[47] 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.[48] Another example is that consumer preferences, social norms, or policies at different levels – for example with regard to organic farming – may have an impact on pesticide usage in agricultural production. This in turn could have an effect on biodiversity and ecosystem services.[49] Change may be slow, such as degradation of ecosystem services due to agricultural intensification, or change may be fast, such as introduction of new regulation in the wake of a crisis (a historical example is the response to mad cow disease).[50] 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 with regard to 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.[51]

This assumption, that the world is characterised by rapid social, technological, and ecological changes that are not linear or foreseeable but include irregular responses, surprises, and cascading effects,[52] has implications for the understanding and governing of social-ecological systems. Inevitably, it calls for governance that is able to deal with profound uncertainty.[53]

3.2 The Concept of Resilience

In relation to social-ecological systems, the concept of resilience may have two functions that should be distinguished.[54] The first of these is that it may be a property of a system, i.e. may serve to describe a system characteristic. This characteristic has been defined in variety of ways. The most popular definition reads 'the capacity of a system to absorb disturbance and still retain its basic structure and function'.[55] The term resilience has its roots in the discipline of ecology, introduced by C.S. Holing in the early 1970s. Holing used the term resilience to refer to the capacity of an ecosystem to stay within a stable state, i.e. the

[46] Biggs, Schlüter and Schoon (n 27) 8, with reference to Folke and others (n 27).

[47] Biggs, Schlüter and Schoon (n 27) 8, with references to Folke and others (n 27); Carl Folke and others, 'Adaptive Governance of Social-Ecological Systems' (2005) 30 Annu Rev Env Resour 441, 443.

[48] Rockström and others (n 20).

[49] Biggs, Schlüter and Schoon (n 27) 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.

[50] 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.

[51] Biggs, Schlüter and Schoon (n 27) 1.

[52] Bohman (n 29) 26.

[53] Biggs, Schlüter and Schoon (n 27) 12.

[54] Ibid. 13.

[55] Tracy-Lynn Humby, 'Law and Resilience: Mapping the Literature' (2014) 4 Seattle J Envtl L 85, 90, with reference to Walker and Salt (n 27) iii.

amount of disturbance an ecosystem can endure before its controls shift to another stable state.[56] 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.[57]

The second function uses the concept of resilience as 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.[58] 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.[59]

Regarding the function of resilience as an analytical framework, one should note that, in addition to the ability to endure pressures, the resilience perspective has been refined to include the ability of a system to adapt and transform. These three aspects interrelate across multiple scales. Adaptability is part of the resilience perspective, representing the capacity to respond to changing external drivers as well as internal processes and allowing for development and change along the current stable state.[60] In an agricultural context, this could mean replacing pest management strategies that are based on intensive chemical input with crop rotation in order to preserve biodiversity and ecosystem services. Transformability is also part of the resilience concept. This refers to the capacity to cross thresholds and enter into a new stable state.[61] In an agricultural context, this could mean a farmer diversifying into new activities that were previously not considered to be in their remit, such as tourism or energy production.[62] 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.[63] For example, transformation at smaller scales is perceived to enable resilience at larger scales by using crises at smaller scales as an opportunity for novelty and innovation, combining experience and knowledge to navigate transitions.[64] Consequently, analysing social-ecological systems can be carried out along these three inter-dependent dimensions.[65] 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.[66]

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[56] Folke (n 41) 254.
[57] Walker and Salt (n 27) 63.
[58] Biggs, Schlüter and Schoon (n 27) 10, with reference to Folke (n 41).
[59] Biggs, Schlüter and Schoon (n 27) 1.
[60] Ibid. 9, with references to Folke (n 41), and Simon Levin and others, 'Social-ecological systems as complex adaptive systems: modeling and policy implications' (2013) 18(2) Environment and Development 111.
[61] Ibid.
[62] 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, 192.
[63] Biggs, Schlüter and Schoon (n 27) 9, with references to Folke (n 41), and Levin and others (n 60).
[64] Folke and others (n 27).
[65] Humby (n 55) 94, with reference to Steve Carpenter and others, 'From Metaphor to Measurement: Resilience of What to What?' (2001) 4(8) Ecosystems 765.
[66] Humby (n 55) 104–105, with reference to Richard A Barnes, 'The Capacity of Property Rights to Accommo-

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.[67] 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 also include the capacity to manage the system so as to stay within these thresholds.[68] 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, such a system is unsustainable. In fact, it is argued that sustainability is not an appropriate framework for analysing the challenges of social-ecological systems as it lacks capability to provide tools for coping with change, which is seen as an inherent feature of social-ecological systems.[69]

At the same time, 'a system that is unsustainable may still be resilient, although it is likely to be strained'.[70] For example, a system may utilise natural resources in a way that deprives future generations of essential ecosystem services, but the system itself may still be extremely resilient and resistant to change. There are many examples of economic systems being resilient, while at the same time putting unsustainable pressure on ecological systems. However, the longer unsustainable behaviour continues in a system, the more likely it is that its resilience capacity will decrease.[71]

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.[72] 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.[73] 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.[74] Within resilience research, it is suggested that analysing only the social or the ecological systems will lead to too narrow conclusions, and that these conclusions will subsequently be insufficient for guiding society towards sustainability.[75] Indeed, not neglecting social perspectives may be essential for achieving sustainable agricultural production. In an agricultural context with private ownership, it is the farmer's right to manage their property in accordance with their preferences. Hence, it is to a large extent social subjects that ultimately decide (taking into account regulations and

date Social-Ecological Resilience' (2013) 18(1): 6 Ecology and Society.

67 Saxer and Rosenbloom (n 45) 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.

68 Walker and Salt (n 27) 63.

69 Saxer and Rosenbloom (n 45) 58.

70 Ibid. 56.

71 Ibid. 57.

72 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).

73 Bohman (n 29) 37.

74 Carl Folke and others, 'Adaptive Governance of Social-Ecological Systems' (2005) 30 Annu Rev Env Resour 441, 443.

75 Ibid.

market conditions) how much and which pesticides are to be used on 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.[76] Another important social aspect is that of agriculture providing viable livelihoods for local people.[77] Without this, 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 develop. In such a scenario, one can expect the wider social-ecological system of rural areas to also be affected.

Further addressing the normative dimensions of the perspectives of resilience and sustainability, it is argued that sustainability includes value judgements by finding something to be good and desirable, and therefore deciding that it should be sustained.[78] Accordingly, sustainability has a normative dimension. In comparison, it is argued that resilience as an analytical tool assesses the state of a system and its ability to retain core characteristics, not whether these core characteristics are desired or undesired.[79] One should, however, remember that decisions about governance of social-ecological systems inevitably require trade-offs that are inherently political. Different sectors and groups prefer, need and demand different values and functions. These trade-offs will be influenced by issues of power and inequality.[80] Despite acknowledging the importance of not neglecting the social aspect in analysing social-ecological systems, the resilience perspective largely lacks attention to phenomena such as agency, conflict and power.[81] Applying social-ecological resilience theory uncritically may thus implicitly recognise the interests and preferences of some groups, while ignoring the interests and preferences of others.[82]

3.4 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, absorb stress and external disturbances, manage non-linear effects, cross thresholds, and adapt to new circumstances.[83] 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.[84]

There are often normative ends in legal systems related to concepts such as justice and the rule of law.[85] The rule of law implies constraints on the power of government and is often understood as ensuring legal certainty and predictability. Through this, 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. It is argued that legal certainty is essential for establishing trust in government and making it possible for individuals to plan their behaviour without unexpected public interference, or interference

[76] Darnhofer, Fairweather and Moller (n 62) 192–193.
[77] Angelo and Reilly-Brown (n 43) 724.
[78] Saxer and Rosenbloom (n 45) 58.
[79] Ibid.
[80] 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.
[81] 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.
[82] Schoon and others (n 80) 32–34.
[83] Jonas Ebbesson and Ellen Hey, 'Introduction: Where in Law is Social-Ecological Resilience?' (2013) 18(3): 25 Ecology and Society.
[84] Humby (n 55) 105.
[85] Ebbesson and Hey (n 83).

from other individuals.[86] 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 such as: protecting biodiversity; enhancing the competitiveness of an industry sector; or establishing a functioning market.[87] In the light of these aspects, the law may be considered important for providing both social stability and stability in human interactions. When viewing democracy, economic stability, and general development as parts of the resilience of a social system, the features of the rule of law and legal certainty are essential from a social-ecological resilience perspective.[88]

However, these traditional legal features may at the same time decrease the overall resilience capacity of social-ecological systems. Features that have been identified as fostering 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 development).[89] Thus, linking resilience theory with legal research means joining two domains that come with a variety of different normative values. It is however concluded that the law itself does not necessarily hinder ambitions to create resilient social-ecological systems. Instead 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 utilising different arguments, from different sources, and weighing those against each other to determine which particular interpretation should triumph.[90]

Despite being embraced by legal scholars as an analytical framework, it is nevertheless questioned if the resilience perspective can be applied in an equal manner 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 relating to resilience were established in the field of ecology and the resilience of social systems may rely upon fundamentally different factors to that of the resilience of ecological systems.[91] Since social systems are socially constructed, the result of human ideas and thoughts, it is argued that the understanding of them must be fundamentally different.[92] This implies possible risks when applying social-ecological resilience theory in legal research and calls for cautiousness and close scrutiny of the accuracy of the results of such research.

4. Evaluating EU Pesticides Law

4.1 Adaptive Law for Social-Ecological Resilience?

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. However, from a resilience perspective an evaluation employ-

[86] 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).

[87] Ebbesson and Hey (n 83).

[88] Bohman (n 29) 379.

[89] Ebbesson and Hey (n 83).

[90] Ebbesson (n 86) 421.

[91] Bohman (n 29) 43.

[92] Saxer and Rosenbloom (n 45) 25, with reference to Olsson and others (n 81).

ing the theoretical perspective of adaptive law should not be considered exhaustive. For example, fostering complex adaptive systems thinking – which is considered a key principle for resilience building[93] – seems often to be neglected in adaptive law theories. Another example is that the notion of transformability, i.e. the capacity to cross thresholds and enter into new stable states, is poorly reflected.[94] In adaptive law theory it seems that the focus instead is on development along the current stable state. Consequently, in an analysis based on adaptive law theory there is a risk that the transformability aspect of resilience is overlooked. Finally, one should note that resilience may be reflected in governance measures and other structures beyond the law.[95] Law is only one of many factors that affect the capacity of social-ecological systems to handle uncertainty and change.[96]

Nevertheless, the insights provided by 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 in absorbing shocks and disturbances up to a certain point. However, the insights on the scale and pace of change in social-ecological systems that is characterised as abrupt, unexpected, and non-linear, require the law to be flexible and adaptive. If not, the law can contribute to ecological and subsequently social collapse.[97] This call for adaptivity may, however, present 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.[98]

In short, the incorrect perspective of nature refers to an incorrect view of ecological systems and their links to social systems.[99] For example, the foundations of U.S. environmental law reflect the assumption that nature is relatively stable, predictable, and mostly changes in a linear way.[100] With regards to 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 with regards to one interest, but with regards to several interests. This weakens the resilience of the ecological systems and subsequently the resilience of social-ecological systems.[101] 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 across different scales. More specific issues identified are the preference for a strong centralised government which is often poorly matched to the scale, scope, and speed at which

[93] 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) 142 ff.

[94] See above section 3.2.

[95] Bohman (n 29) 394.

[96] Ebbesson and Hey (n 83).

[97] Craig Anthony Arnold and Lance H Gunderson, 'Adaptive Law and Resilience' (2013) 43(5) Environmental Law Reporter 10426, 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.

[98] Humby (n 55) 107.

[99] Ibid. 107–108.

[100] Arnold and Gunderson (n 97) 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.

[101] Humby (n 55) 108–109.

stress occurs in social-ecological systems. Another issue is the approach of choosing one particular mode, instrument, or method as the 'optimal': a one-size-fits-all approach. It is suggested that this increases vulnerability and weakens the capacity to address the complexity and unpredictability of social-ecological systems.[102] Finally, the nature of legal processes and legal values may hinder adaptivity. It is claimed that this results in a tendency to establish 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.[103] Moreover, environmental law and natural resource law also often lack efficient feedback-loops or if they do exist, they are not utilised.[104]

Turning a critical lens on adaptive law theory, one may note that adaptive law, as a theoretical concept, is neutral. Thus, a strong call for adaptive law raises the question of adaptivity for whom? In regards to which interests and preferences will the law provide adaptivity? Adaptivity may further the cause of the environmentalist or it may further the interests of the industrialist who wants to derogate from environmental protection measures.[105] Another example is that the relationship between, on the one hand, the resilience perspective 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.[106]

4.2 A Developed Understanding of Adaptive Law

Soininen and Platjouw suggest a developed understanding of adaptivity, namely 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 by, *inter alia*, crafting: legal rules for withstanding unexpected environmental, social, economic, and cultural changes; strict procedural rules concerning evaluating evidence and the burden of proof; as well as strict criteria for legal argumentation.[107] On the other hand, the management of social-ecological systems needs to be adaptive to the law. The functions of predictability and permanence are required in certain situations, as opposed to always requiring adaptivity.[108] 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.[109]

Without these functions, neither knowledge of nor changes to the law will effectively contribute

[102] Ibid. 110–112.
[103] Ibid. 114, with references to Arnold and Gunderson (n 97) 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.
[104] Humby (n 55) 114, with reference to Arnold and Gunderson (n 97) 10440.
[105] Soininen and Platjouw (n 33) 29.
[106] Humby (n 55) 129.
[107] Soininen and Platjouw (n 33); 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.
[108] Soininen and Platjouw (n 33) 29.
[109] Ibid. 25.

to social-ecological resilience.[110] Thus, the rule of law and legal certainty may be crucial for adaptation of social behaviour, and subsequently for ensuring resilience capacity. With this perspective, adaptivity should not only mean that the law should be adaptive in relation to dynamics 'external' to the law, but that human behaviour should be adaptive to requirements of the law. Put simple, 'law should be a careful combination of adaptivity and certainty, rule of science and rule of law'.[111]

4.3 Establishing Evaluative Criteria

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. Soininen and Platjouw identify a number of legal features that contribute to the adaptive and resilience capacity of the law. In light of this, they suggest a number of specific criteria for measuring the resilience and adaptivity of environmental regulatory instruments. 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'.[112] 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 do not address all aspects that may be of relevance in evaluating the resilience capacity of EU pesticides law. However, they are based upon, and include, central aspects of the resilience perspective which are of relevance in a legal context. Thus, they should be able to provide an indication of the resilience and adaptive capacity of EU pesticides law.

In the following section, the fundamentals of Regulation 1107/2009 (PPP Regulation) and Directive 2009/128/EC (SUD) are presented. The PPP Regulation and the SUD are then evaluated against the adaptive law criteria presented

[110] Ibid. 26.

[111] Ibid. 25–26.

[112] Ibid. 26. In the discussion preceding the suggested criteria, references are made, inter alia, to Craig (n 100); Arnold and Gunderson (n 97); Jan McDonald and Megan C Styles, 'Legal Strategies for Adaptive Management under Climate Change' (2014) 26(1) Journal of Environmental Law 25; Ruhl (n 103); Andrea M Keesen and Helena FMW van Rijswick, 'Adaptation to Climate Change in European Water Law and Policy' (2012) 8 Utrecht L Rev 38; Lorenzo Squintani and Helena van Rijswick, 'Improving Legal Certainty and Adaptability in the Programmatic Approach' (2016) 28(3) Journal of 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 107); 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 86); 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.

above. More specifically, the provisions of these instruments are read in light of the criteria and interpreted in accordance with the methods described above in section 2.4. The functions and characteristics that are found by this reading and interpretation are linked and compared with the functions and characteristics specified in the adaptive law criteria. The results are presented in regard to each criterion and followed by a conclusion on whether the criterion at hand should be considered to be reflected within these instruments.

4.4 Fundamentals of EU Pesticides Law

In short, the PPP Regulation lays down rules for authorising the sale of PPPs, as well as the use and control of these products. The authorisation process is carried out within a dual system, where the competence is split between EU level and Member State level. A PPP is usually made up of several components, where the component intended to give effect against pests is called 'active substance'.[113] Active substances are approved at EU level according to harmonised rules.[114] The same approval procedure is prescribed for safeners and synergists (chemicals used to reduce the effects of the PPP on certain plants and chemicals added to improve the functioning of the active substance of the PPP).[115] The PPP, the specific commercial product that contain active substances as ingredients, are authorised at Member State level.[116] The SUD sets out rules for the sustainable use of pesticides, including PPPs. In other words, the PPP Regulation and the SUD 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.[117]

This regulatory package is informed by five normative principles for risk assessment and management, namely

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

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.[118] 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.[119] The PPP Regulation identifies seven hazards that are considered unacceptable, referred to as 'cut-off criteria'. If an active substance meets any of these criteria, it is banned without any further assessment of the likelihood of harmful effects to occur.[120]

This hazard-based approach goes hand in hand with the precautionary principle. This principle is put forward as a key norm in both the PPP Regulation and the SUD.[121] A basic understanding of this principle is that regulatory action should be taken, and that it should aim to reduce potential harm, when there is scientific

[113] PPP Reg, art 2.2.
[114] Ibid. art 13.
[115] Ibid. art 25.
[116] Ibid. art 28.1.
[117] SUD, recital 3.
[118] Bozzini (n 3) 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.
[119] Bozzini (n 3) 30; Ragnar E Lofstedt, 'Risk versus Hazard – How to Regulate in the 21 st Century' (2011) 2(2) European Journal of Risk Regulation 149, 149.
[120] Bozzini (n 3) 30–31; PPP Reg, Annex II 3.6–10.
[121] PPP Reg, art 1.4; SUD, art 2.3.

uncertainty over risks associated with a certain product and it is not possible to establish whether using the product is safe.[122]

The EU has not only taken regulatory action in regard 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'.[123]

The principle of substitution is expected to contribute to the overall aim of EU pesticides regulation to achieve the 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 Plans (NAPs), including quantitative objectives, targets, measures, timetables and indicators for achieving a sustainable use of pesticides.[124] The SUD also contain specific provisions, *inter alia*, prohibition of aerial spraying and promotion of Integrated Pest Management (IPM).[125]

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.[126] 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'.[127] 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.[128]

4.5 Substance

4.5.1 Plurality of Substantive Goals

Within social-ecological resilience theory, diversity is generally emphasised as an important feature for 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 disturbance.[129] Soininen and Platjouw put forward plurality and diversity as important in regard to the goal (or goals) attached to a regulatory instrument. They suggest that the substantive goals should simultaneously acknowledge environmental, social and economic aspects.[130] At the same time, the goals should be

[122] Bozzini (n 3) 33.
[123] Ibid. 39; PPP Reg, art 24.
[124] SUD, art 4.1.
[125] SUD, arts 9 and 14. IPM is a set of practices, centred around reduction of chemical use, and anticipation and prevention of pests, varying depending on the local conditions (Bozzini (n 3) 42; SUD, art 3.6).
[126] Bozzini (n 3) 43.
[127] PPP Reg, art 40.
[128] Bozzini (n 3) 43; PPP Reg, Annex I.
[129] 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 27); Jon Norberg and Graeme Cumming, *Complexity Theory for a Sustainable Future* (Columbia University Press 2008).
[130] Soininen and Platjouw (n 33) 26.

clear so that the legality of management measures can be judged against the goals.[131] Two suggestions are put forward 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.[132]

Reflecting upon this criterion, one may ask, to begin with, how compatible substantive goals of diverse character actually are with the requirement of clear goals. Furthermore, considering the 'planetary boundaries' perspective with certain ecological thresholds, there may be conflicts where it will be required to grant environmental considerations primacy. It is observed that when priorities have to be made between multiple goals, economic considerations tend to trump ecological conservation.[133] A resilience perspective does not require that environmental considerations should be granted primacy in all conflicts.[134] Nevertheless, the resilience perspective 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.[135] Arguably, only having a plurality of substantive goals, or diverse substantive goals, does not automatically incorporate these insights into the regulatory goals.

Leaving this reflection, one can conclude that together, the PPP Regulation and the SUD have a diverse set of goals where ecological objectives are coupled with social objectives. The purpose of the PPP 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'.[136] As regards the goal of the SUD, it is shortly stated 'this Directive establishes a framework to achieve a sustainable use of pesticides (…).[137] Together these goals are so broad that they are, at the outset, able to address conflicts between ecological and social considerations.

From the wording of the provision stating the goals of the PPP Regulation, 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'.[138] 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.

Moreover, the goals of the PPP Regulation and the SUD are general and ambiguous. The wording of the goals cannot be considered precise and clear. By turning to interpretative aids, such as recitals, and by employing systemic and teleological methods of interpretation, these goals may be clarified to some extent.[139] Despite

131 Ibid.
132 Ibid.
133 Marilyn Averill, 'Introduction: Resilience, Law and Natural Resource Management' (2008) 87(4) Nebraska Law Review 821, 824–825.
134 Humby (n 55) 109, with reference to Arnold and Gunderson (n 97) 10438.
135 Humby (n 55) 109.
136 PPP Reg, art 1.3.
137 SUD, art 1.
138 PPP Reg, recital 24.
139 See e.g. Ibid., recital 8–9, and SUD, recital 22.

this, a considerable amount of vagueness remains.

To conclude, the 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 adaptation to change.[140] 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.[141] Accordingly, adaptive law theory often suggests flexible standards, or principles, that allow managers discretion to consider the insights of new scientific knowledge.[142]

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 (…).'[143]

With regards to renewals of approvals, it is specifically pointed out in the recitals that 'experience 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 a decision is taken regarding the renewal of an approval.[144]

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

> '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. (…) The Member State

[140] 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 27); F Stuart Chapin and others (eds), *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World* (Springer Science & Business Media 2009).

[141] Cundill and others (n 140) 174.

[142] Arnold and Gunderson (n 97) 10436.

[143] PPP Reg, art 21.1 and 21.3. 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, while Art 44(1) concerns the authorisation of PPPs.

[144] PPP Reg, recital 15.

> 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 (…).'[145]

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.'[146]

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.[147]

To conclude these instruments, and especially the PPP Regulation, allow for consideration of new scientific knowledge and adjustment of 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 regard to measures for achieving sustainable use of pesticides. The inclusion of these functions in these instruments should contribute to their resilience and adaptive capacity.

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 procedures for enabling this. Accordingly, iterative management processes that facilitate learning are put forward.[148] It is deemed essential that constant monitoring of the environmental media, and the human pressures affecting these, are included in these procedures.[149]

The PPP Regulation and the SUD lay down procedures for knowledge generation through the monitoring of both the environmental media, including human health, as well as the human pressures affecting them (the usage of pesticides). Regarding increasing knowledge, the PPP Regulation, inter alia, lays down that producers of PPPs are obliged to carry out post-authorisation monitoring if requested by the competent authority.[150] They shall also provide all data relating to the volume of sales of PPPs, in accordance with EU legislation concerning statistics on PPPs.[151] Moreover, the holder of a PPP authorisation 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.[152] For this purpose, the authorisation holder is required to record and report all suspected adverse reactions in humans, animals and 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

[145] Ibid. arts 44.1 and 44.3.
[146] Ibid. arts 69–71.
[147] SUD, arts 5.3, 8.7, 14.4 and 15.1.
[148] Soininen and Platjouw (n 33) 26.
[149] Craig (n 100) 40–43.
[150] PPP Reg, art 67.2.
[151] Ibid. art 67.3.
[152] Ibid. art 56.1.

public bodies which authorise PPPs in non-EU countries.[153] 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.[154] Finally, 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 where and the crop on which the PPP was used. These records should be kept for at least three years and be made available upon request to the competent authority.[155]

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.[156] Member States 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 and to other Member States, as well as make them available to the public.[157] 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'.[158]

The feature of iteration is reflected in regard to the fundamental means of the PPP Regulation. There are structures for reviewing management measures, such as time-limited approvals and authorisations with subsequent renewal procedures.[159] Regarding iteration of the processes of the SUD, it is laid down that the NAPs should be reviewed, at least every five years.[160] As concerns certain features of the NAPs, Member States are obligated to establish procedures for the granting, renewal, and withdrawal of training certificates.[161] This implies iteration of the learning processes prescribed for professional users, distributors, and advisors. At the EU level, one may note that the Commission 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'.[162]

To sum up, the PPP Regulation and the SUD lay down procedures for knowledge generation through monitoring of the environmental media, including human health, as well as of the activity of pesticides usage. The feature of iteration is reflected in regards of the fundamental means of the PPP Regulation and in relation to the NAPs. Without judging on the efficacy of this knowledge generation and iteration, one can conclude that these functions are reflected within these instruments. Thus, these instruments meet the criteria of both 'increasing knowledge' and of 'iterative management', which is considered to contribute 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 sys-

153 Ibid.
154 Ibid. art 56.4.
155 Ibid. art 67.1.
156 SUD, art 4.2.
157 Ibid. art 15.2–3.
158 Ibid. art 7.2.
159 PPP Reg, arts 5, 14.2, 25.2. and 32.1.
160 SUD, art 4.2.
161 Ibid. art 5.2.
162 Ibid. art 16.

tems 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.[163] 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.[164] Soininen and Platjouw's suggested 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 should 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.[165]

In short, the approval process of active substances, safeners, and synergists is mostly concentrated at the EU level, while the authorisation process of PPPs, and the planning for achieving a sustainable use of pesticides, are concentrated at the Member State level. EU institutions and national authorities are however involved in both of these processes.[166] It is also allowed for participation of other Member States than the one receiving an approval application or an authorisation application.[167] 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.[168] In the adoption of NAPs, interests related to other sectors, as well as all stakeholder groups shall be taken into account.[169] 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.

To sum up 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 still room for improvement. These functions, as currently laid down, contribute to the adaptive and resilience capacity of these instruments. However, it is possible to improve these functions to further enhance adaptive and resilience capacity.

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[163] 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.

[164] Ibid. 83, with reference to Magnus Nyström and Carl Folke, 'Spatial Resilience of Coral Reefs' (2001) 4(5) Ecosystems 406.

[165] Soininen and Platjouw (n 33) 27, with references to Craig (n 100) 53–63, and Keesen and van Rijswick (n 112) 41.

[166] PPP Reg, arts 7.1, 11.1–2, 13.1, 21.1–2, 33.1, 36.2–3, 79.1; SUD, arts 4.1–2, 15.1, 15.4; 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.

[167] PPP Reg, arts 12.1 and 36.1.

[168] PPP Reg, art 12.1; SUD, arts 4.1, 4.5; 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.

[169] SUD, art 4.5.

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.[170] This could mean anything from simply keeping stakeholders informed to complete devolution of power.[171] It is assumed that involving a diverse group of stakeholders will contribute to legitimacy and 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.[172] In this light, Soininen 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. The PPP Regulation and the SUD are evaluated against this criterion in both this and the following sections.

With regards to access to information under the PPP Regulation, it is, *inter alia*, 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.[173] The applicant may request certain information and certain parts of the dossier to be kept confidential.[174] 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'.[175] The draft assessment report of the approval procedure 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.[176] The conclusion, adopted during the approval procedure on whether the active substance at issue can be expected to meet the approval criteria, shall also be made available to the public.[177] Finally, the Commission should maintain a list of approved active substances available to the public electronically.[178]

In regards of authorisations of PPPs, it is, *inter alia*, laid down that Member States shall keep information on authorised or withdrawn PPPs available to the public electronically.[179] 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 were necessary for first authorisation, amendment of the authorisation conditions, or renewal of the authorisation.[180] 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 with regard to the records on the use of PPPs, including time

[170] Anne M Leitch and others, 'Principle 6 – Broaden Participation' 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) 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.

[171] Leitch and others (n 170) 201.

[172] Bohman (n 29) 314, with reference to Thomas M Franck, 'Legitimacy in the International System' (1988) 82(4) American Journal of International Law 705.

[173] PPP Reg, art 10.

[174] Ibid. art 7.3. However, this is without prejudice to Directive 2003/4/EC which concerns public access to environmental information, (PPP Reg, 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).

[175] PPP Reg, art 10.

[176] Ibid. art 12.1.

[177] Ibid. art 12.2.

[178] Ibid. art 13.4.

[179] Ibid. art 57.

[180] Ibid. art 60.2.

and dose of application, as well as area and crop on which the PPP was used. The competent authorities shall provide access to this information in accordance with applicable national law or EU law.[181]

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.[182] 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.[183] As regards information on the risks and monitoring of pesticide usage, this information shall be made available to the public. The risk indicators calculated by the Commission at EU level shall also be made available online to the public.[184] 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.[185]

To conclude, apart from acknowledging commercial interests among producers to keep certain information confidential, the public, including stakeholders, is 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.

4.6.4 Access to Justice

Looking into the function of access to justice for stakeholders, one should initially note that the Court of Justice of the European Union (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.[186] In the Treaty on the Functioning of the European Union (TFEU), 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.[187]

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.'[188]

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'.[189] 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

[181] Ibid. art 67.1.
[182] SUD, art 4.4.
[183] Ibid. art 4.5; Dir 2003/35/EC, art 2.
[184] SUD, art 15.4.
[185] Ibid. art 7.1.

[186] Consolidated Version of the Treaty on the Functioning of the European Union [2012] OJ C326/1 (hereinafter TFEU), art 263.
[187] Ibid.
[188] 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 T420/05 *Vischim v Commission* [2009] ECLI:EU:T:2009:391, para 72, and T483/11 *Sepro Europe v Commission* [2013] ECLI:EU:T:2013:407, para 30.
[189] Case T584/13 *BASF Agro BV and Others v European Commission* [2018] ECLI:EU:T:2018:279, para 45.

by an association of producers of copper compounds against a Regulation that included copper compounds on the list of candidates for substitution.[190] 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.'[191]

Their appeal was hence considered inadmissible.[192] One may note that individual parties wishing to review EU legislation have an additional option through indirect judicial review. This means that judicial review can be brought as part of a preliminary ruling procedure under article 267 of the TFEU on any Union act, on any grounds, and by anyone, i.e. there are no requirements for direct and individual concern.[193] 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.[194]

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.[195]

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.[196]

As concerns access to justice in relation to the right to access to information, no specific provisions are laid down either in the PPP Regulation, or in the SUD. However, it is laid down in the PPP Regulation that the provision laid down therein, which make it possible to keep information submitted under the Regulation confidential, apply without prejudice to Directive 2003/4/EC, which concerns public access to environmental information.[197] This Directive obligates Member States to ensure access to justice for applicants requesting information.[198]

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, is ensured through these instruments or within the wider legal structure of the Union. This also 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 to be 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).[199] In this light, stakeholders' access to justice in relation to management measures under these instruments may be considered as limited. 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 hamper adaptive and resilience capacity of these legal instruments.

[190] Case C-384/16 P *European Union Copper Task Force v European Commission* [2018] ECLI:EU:C:2018:176.
[191] Ibid. para 97.
[192] Ibid. para 122.
[193] TFEU, art 267.
[194] Schütze (n 38) 365.
[195] TFEU, art 263.
[196] PPP Reg, art 36.3.
[197] PPP Reg, art 63.3; Dir 2003/4/EC.
[198] Dir 2003/4/EC, art 6.
[199] Bozzini (n 3) 47.

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). 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'.[200] A characteristic of 'command and control' is that 'very little, if anything, is left for the addressee of the law to variate'.[201] From a resilience perspective, other types of policy instruments – in particular economic instruments but also purely voluntary instruments, such as measurements for spreading of information – are deemed crucial as complements to direct legal regulation. 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.[202]

Since having the form of a Regulation, the PPP Regulation is binding in its entirety and directly applicable in all Member States.[203] 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 represents a typical 'command and control' approach, and consequently has the character of direct legal regulation.

The SUD differs 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 the form and method they use to achieve these ends.[204] In the recitals of the SUD, complementary policy measures are generally acknowledged in the governing of pesticide usage. More specifically, it is stated that

> '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.'[205]

To conclude, economic policy instruments are explicitly encouraged but not directly coupled with either the PPP Regulation or the SUD. To some extent, the SUD goes beyond direct legal regulation by obligating Member States to take certain measures in order to achieve certain ends, but leaving the Member States to decide the exact content and forms of these measures. Nevertheless, these two instruments arguably do 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

4.8.1 Legally Binding and Specific Obligations to Achieve Goals; Time Limits for Goals; Sanctioning of Non-Compliance

Social-ecological systems comprise of, and are affected by, a number of variables that change and

[200] Westerlund (n 29) 9, 29.
[201] Ibid. 32.
[202] Arnold and Gunderson (n 97) 10432–10436.
[203] Paul Craig and Gráinne De Búrca, *EU Law: Text, Cases, and Materials* (6 edn, Oxford University Press 2015) 107.
[204] Ibid. 108.
[205] SUD, recital 4.

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 as methods of crop production or allocation of financial resources.[206] Feedback is when change in a particular variable of a social-ecological system leads to changes in the system and then those changes eventually loop back, affecting the original variable.[207] The importance of managing especially slow variables and feedbacks is put forward in resilience research as a key principle for resilience building. Otherwise, certain thresholds may be crossed and a system may shift from one regime to another. This is often associated with large, rapid changes to ecological systems which in turn could have an immense impact on social systems. In light of this, the control and management of slow variables and feedbacks is considered essential for contributing to the capacity to maintain the desired functions of social-ecological systems, restore social-ecological systems to more desired states, or transform them to entirely new states.[208] Moreover, sanctioning systems, intended to ensure compliance by all actors, are considered vital for trust-building which, from a resilience perspective, is in turn important for maintaining institutional stability and continuity in management.[209] The criteria of legally binding and specific obligations to achieve goals, the setting of time limits within which to achieve these goals, and the sanctioning of non-compliance may all be understood from this perspective of social-ecological resilience theory.

Since it has the form of a regulation, the PPP Regulation is binding in its entirety and directly applicable in all Member States.[210] 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 it takes the form of a Directive, it is binding only in regard to the results to be achieved, and only upon the Member States to which it is addressed.[211] This Directive is addressed to the Member States, thus it is binding upon all Member States.[212] It contains specific obligations to adopt NAPs, including obligations on what should be included in these.[213]

The substantive goals of both instruments, 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.[214] The procedural goal of the SUD to adopt NAPs is coupled with a certain deadline, and many of the other procedural goals of the SUD have time limits.[215]

As regards the sanctioning of non-compliance, Member States are obligated to lay down penalties applicable to infringements of the PPP Regulation.[216] A similar obligation is laid down in the SUD, obligating Member States to determine penalties applicable to infringements of national provisions adopted pursuant to the SUD.[217] 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.[218] In the scenar-

[206] 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.
[207] Ibid.
[208] Ibid. 105.
[209] Bohman (n 29) 314, with reference to Franck (n 172).
[210] TFEU, art 288.
[211] Ibid.
[212] SUD, art 25.
[213] Ibid. arts 4–15.
[214] TFEU, art 288.
[215] SUD, arts 4.2, 5, 6, 7, 8, 14 and 17.
[216] PPP Reg, art 72.
[217] SUD, art 17.
[218] TFEU, arts 258–259.

io 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.[219]

To conclude, two of these criteria, the binding and specific obligations, and the sanctioning of non-compliance, are to be considered fulfilled. The inclusion of these functions is assumed to contribute to the 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 the adaptive and resilience capacity of these instruments.

5. Conclusions and Reflections

5.1 Letting Social-Ecological Resilience Theory Inform EU Pesticides Law

The first research question of this article 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 while traditionally, legal systems and legal structures have struggled to deal with these factors. 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.

From the perspective of 'planetary boundaries', there are ecological thresholds that should not be transgressed so as to prevent the possibility of putting 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 it does provide 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 are actually 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 the transgression of 'planetary boundaries'. Trade-offs between interests will inevitably be influenced by the distribution of power among actors and between different preferences. 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 factor may be critical for keeping human activities, including pesticide usage, within ecological thresholds. These perspectives on the issue of power are relevant in relation to political decision-making but also in relation to the law.

[219] TFEU, art 260.

However, within adaptive law theory there also is a lack of attention to power. Adaptive capacity of the law is likely to be necessary to adjust human behaviour so as 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 create EU pesticides law in a way that it does not obstruct but instead makes it possible to handle challenges of change, shock, pressure, uncertainty, and complexity related to pesticide usage. However, letting social-ecological resilience theory inform EU pesticides law may not be sufficient in itself 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, with attention to issues of power, are likely to be necessary to guarantee that such critical boundaries are not actually transgressed.

5.2 Adaptive and Resilience Capacity of EU Pesticides Law

The second and third research questions concern: whether adaptive capacity, contributing to social-ecological resilience, is currently reflected within EU pesticides law; and whether it can be increased, and if so in what aspects. The result of the evaluation of EU pesticides law against the chosen adaptive law criteria indicates that these instruments have largely good adaptive and resilience capacity. Out of 10 evaluative criteria 6 are fulfilled, 3 are partly fulfilled and 1 criterion is not fulfilled. More specifically, adaptive and resilience capacity is reflected in regards of substantive goals, management adjustment in the light of new scientific understanding, increasing knowledge, iteration of management processes, access to information, obligations to achieve procedural and substantive goals, and the sanctioning of non-compliance. These capacities identified within EU pesticides law are considered to contribute to features such as diversity, encouraging learning, broadened participation, and the management of slow variables and feedbacks, which are all considered key elements for building resilience within social-ecological systems. Adaptive capacity is however not reflected in regard to instrument choice and access to justice, and only partly reflected as concerns crossing sectoral, jurisdictional and public/private boundaries, as well as in regard to time limits for goals. In these aspects, it is possible to improve EU pesticides law to further contribute to features important for resilience building, *inter alia*: connectivity, broadened participation (including legitimacy), and the management of slow variables and feedbacks.

To conclude, adaptive capacity (as interpreted within the chosen evaluative criteria), contributing to social-ecological resilience, is largely reflected within the PPP Regulation and the SUD. This implies that EU pesticides laws contributes to the capacity to address and handle change, pressure, shock, uncertainty, and complexity related 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 further implies the capacity to identify critical thresholds within the ecological systems, *ergo* enabling governance measures and

decisions to adjust human activities so that they do not transgress 'planetary boundaries'. Since there is room for improvement 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.

One should finally note that this analysis and exploration of potential ways to improve EU pesticides law is largely theoretical. While adaptive and resilience capacity of these legal instruments is largely well reflected *de jure*, further analysis of a more empirical character is needed to provide knowledge of how, and in what ways, these instruments *de facto* contribute (or do 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 do not contribute) to the resilience of social-ecological systems.