Shorelines of adaptation and fields of innovation

Emerging sustainability transformations in sea-level rise planning and the food system

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I've been thinking what to do with my future. I could be a mud doctor, checking out the Earth, underneath.

Linda Manz, as Linda, *Days of Heaven* (Malick, 1978)

Summary

This licentiate thesis builds on the understanding that there is an urgent need for radical and systemic transformations towards sustainability in all parts of society, since current socio-ecological relations are highly unsustainable. The aim of the thesis is to explore emerging societal transformations towards strengthened sustainability through case studies within planning for sea-level rise and the food system, respectively.

A warmer climate leads to rising sea levels. Although it is uncertain how fast sea levels will rise, and by how much, preparing and adapting to sea-level rise is crucial for society. The global food system is profoundly unsustainable and in need of transformations to sustainability. This thesis links two separate studies, one examining the state of planning for future sea-level rise in Swedish municipalities, the other exploring to what extent organic food initiatives can push the dominant food system in the direction of sustainability transformations. In both studies, the main methods used are qualitative interviews and document surveys.

The results show that transformational change towards sustainability builds on different strategies in different fields. Whereas in planning for sea-level rise the emphasis lies on *handling* and *adapting to* one of the main impacts of climate change, rising sea levels, under conditions of uncertainty, the focus within food systems change directed at sustainability lies on *creating* sustainable alternatives that can challenge the dominant food regime. However, in both fields there is a need for moving from a currently dominant regime or paradigm to one characterized by sustainability and dynamic robustness, respectively. This requires a shift in understanding of socio-ecological relations, in turn connected to values and politics.

Key recommendations from this thesis include that planning for sea-level rise should be guided by dynamically robust planning approaches, worst-case scenarios for future sea-level rise should be taken into account, a long-term perspective should be considered, and a national strategy for sea-level rise planning in Sweden should be developed. To strengthen the sustainability of the food system, a variety of organic food initiatives, methods and models should be encouraged, organic food initiatives should persistently strive to build niches and alliances departing from Organic 3.0 values, and as sustainability transformations require radical and systemic changes in values, governance, social practices, policies and economic structures, food systems change should be aimed accordingly.

Keywords

Sustainability transformations, sea-level rise, planning, climate change adaptation, uncertainties, robust approaches, sustainable food systems, organic food initiatives, food regimes, Organic 3.0, multilevel perspective (MLP), Sweden.

Sammanfattning

Denna licentiatavhandling bygger på insikten att det finns ett brådskande behov av en radikal systemomställning i riktning mot hållbarhet i alla delar av samhället, eftersom rådande socioekologiska förhållanden är starkt ohållbara. Syftet med avhandlingen är att utforska framväxande samhällsomvandlingar i riktning mot stärkt hållbarhet genom fallstudier inom planering för havsnivåhöjning respektive livsmedelssystemet.

Ett varmare klimat leder till stigande havsnivåer. Även om det är osäkert hur fort och hur mycket havsnivån kommer att stiga är beredskap och anpassning avgörande för samhället. Det globala livsmedelssystemet är djupt ohållbart och behöver ställas om i riktning mot ökad hållbarhet. Denna avhandling kopplar samman två separata studier. Den första undersöker planeringen för stigande havsnivåer i svenska kommuner, medan den andra utforskar i vilken utsträckning ekologiska initiativ kan driva på det dominerande systemet för produktion och konsumtion av mat i riktning mot en hållbarhetsomställning. I båda studierna är kvalitativa intervjuer och dokumentstudier de huvudsakliga metoderna.

Forskningsresultaten visar att en omställning i riktning mot stärkt hållbarhet bygger på olika strategier inom olika områden. Inom planeringen för stigande havsnivåer ligger tonvikten på *hantering av* och *anpassning till* en av klimatförändringarnas främsta konsekvenser, stigande havsnivåer, i ett sammanhang präglat av osäkerhet. När det gäller omvandlingen av livsmedelssystemet i riktning mot ökad hållbarhet ligger fokus istället på *skapandet av* hållbara alternativ som kan utmana det dominerande systemet för produktion och konsumtion av mat. Inom båda områdena finns det emellertid ett behov av att röra sig från ett dominerande paradigm eller en rådande regim mot nya system präglade av dynamisk robusthet respektive hållbarhet. Detta kräver en genomgripande förändring av vår förståelse för socioekologiska förhållanden som i sin tur är kopplad till värderingar och politik.

En viktig rekommendation från denna avhandling är att planeringen för stigande havsnivåer bör vägledas av dynamiskt robusta planeringsstrategier. Dessutom bör värstascenarier för framtida havsnivåhöjning samt ett långsiktigt perspektiv beaktas och en rikstäckande strategi för havsnivåplaneringen bör utvecklas. För att stärka livsmedelssystemets hållbarhet bör en mångfald olika ekologiska initiativ, metoder och modeller uppmuntras. Ekologiska livsmedelsinitiativ bör sträva efter att bygga nischer och samarbeten som utgår från värderingar som vilar på tankarna kring Eko 3.0. Eftersom hållbarhetsomvandlingar kräver radikala systemförändringar vad gäller värderingar, styrelseformer, sociala praktiker, politiska och ekonomiska strukturer, behöver förändring inom livsmedelssystemet inriktas mot detta mål.

Nyckelord

Hållbarhetsomställning, havsnivåhöjning, planering, klimatanpassning, osäkerheter, robusta strategier, hållbara livsmedelssystem, ekologiska livsmedelsinitiativ, livsmedelsregimer, Eko 3.0, flernivåperspektiv (MLP), Sverige.

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آنـــدیا عاشـــــقم

Jacob von Oelreich

Stockholm, May 2017

List of appended papers

Paper A

von Oelreich, J., Carlsson-Kanyama, A., Svenfelt, Å., & Wikman-Svahn, P. (2015). Planning for future sea-level rise in Swedish municipalities. *Local Environment: The International Journal of Justice and Sustainability, 20*, 459–473. Published online 6 September 2013, in print 2015.

Paper B

von Oelreich, J., & Milestad, R. (2016). Sustainability transformations in the balance: Exploring Swedish initiatives challenging the corporate food regime. *European Planning Studies*. Published online 22 December 2016, forthcoming in print.

Contribution to the papers

A. Jacob von Oelreich performed the empirical research and analyzed the results. Jacob wrote most of the paper, with input from all co-authors. The Introduction was written together with Per Wikman-Svahn, who also wrote the Background chapter together with Annika Carlsson-Kanyama. The results were written by Jacob, together with Åsa Svenfelt. The final version of the main text was written in cooperation with Annika Carlsson-Kanyama and Åsa Svenfelt. The Concluding discussion was written in cooperation between all co-authors. The paper is based on the report *Framtida havsnivåhöjning i kommunal planering* (in Swedish) (von Oelreich et al., 2012).

B. Jacob von Oelreich performed the empirical research for the paper in cooperation with Rebecka Milestad. Jacob structured the paper, framed and analyzed the results and wrote most parts of the paper, with input from Rebecka Milestad. The Results were written in cooperation between the two authors, who both contributed to the Discussion and Conclusion of the paper.

Abbreviations

BP – Stiftelsen Biodynamiska Produkter

CAB – county administrative board

CSR – corporate social responsibility

EL – Ekolådan

GHG – greenhouse gas

MLP – multilevel perspective

MSB – Swedish Civil Contingencies Agency

SDGs – Sustainable Development Goals

SLR – sea-level rise

SMHI – Swedish Meteorological and Hydrological Institute

TIC – Techno-Institutional Complex

UB – Upplandsbondens

Contents

1 Introduction

1.1 The need for sustainability transformations

This thesis builds on the understanding that there is an urgent need for radical and systemic transformations towards sustainability in all parts of society (Olsson et al., 2014; Raskin et al., 2002; Steffen, Richardson, et al., 2015), since current socio-ecological relations are highly unsustainable. We live in a context of compounded environmental, climate, socio-economic, and geo-political crisis. This crisis is characterized by devastating degradation of ecosystems (Millennium Ecosystem Assessment, 2005), "staggering environmental impacts" from a profoundly unsustainable global food system (Foley et al., 2011, p. 341), urgent and severe risks to society posed by continued greenhouse gas (GHG) emissions (Hansen et al., 2015), unsustainable socio-economic inequalities undermining democratic institutions (Piketty, 2013) and amounting to an intensifying and extreme "global inequality crisis" (Hardoon et al., 2016), as well as conflicts over resources (King, 2009).

Due to escalating human dominance, our present geological epoch has been termed the Anthropocene (Crutzen, 2002; Crutzen & Stoermer, 2000). Since the mid-twentieth century, the trajectory of the Anthropocene has been defined by a Great Acceleration (Steffen, Broadgate, et al., 2015; Steffen et al., 2007), characterized by rapid growth in global population, as well as in unequally distributed consumption (Steffen, Broadgate, et al., 2015). The Anthropocene is sometimes described as a Hyper-Anthropocene (Hansen et al., 2016), beginning already with the accelerating climate impact resulting from the industrial revolution. Regardless of temporal delimitation, society's current trajectory has propulsed humanity beyond its "safe operating space … with respect to the [functioning of the] Earth System" (Rockström et al., 2009, p. 472). We are rapidly closing in on the "limits to growth", thus risking "catastrophic overshoot" on a global scale (Meadows et al., 2005, p. 2). We are approaching critical tipping points in the Earth System (Rockström et al., 2009; Steffen et al., 2007), risking abrupt, nonlinear and irreversible changes to Earth's diverse web of ecosystems and the Earth System as a whole (Steffen, Richardson, et al., 2015). We are also entering a sixth mass extinction (Ceballos et al., 2015). In short, "we have a global emergency" (Hansen et al., 2016). Consequently, as formulated by Ravetz, "we know that we cannot continue as before" (2006, p. 282).

While long-term climate targets are in place, current climate policies are weak and not sufficient to limit global warming to 1.5 °C or even 2 °C (Sanford et al., 2014). Furthermore, existing policies and measures to limit GHG emissions are seldom implemented, implying that an increasingly steep pathway of transformation is required the longer implementation is delayed (Luderer et al., 2013). As a consequence of inaction, we are approaching irreversible climate thresholds (Kjellén et al., 2015).

The urgency to achieve transformations to sustainability (Olsson et al., 2014; Hinrichs, 2014) and socio-ecological resilience (Westley et al., 2011) should be seen in light of these and other deeply challenging and accelerating trends. Sustainability transformations may take diverse forms. Whereas certain transformations focus on counteracting negative environmental impacts, thus being aimed at transforming society to handle and adapt to environmental and climatic changes that will or may occur, other transformations are aimed at initiating or creating change through strengthening sustainability. In this thesis, the focus lies on approaching sustainability transformations in two ways, in terms of: 1)

societal transformations to *handle climate change*; and 2) societal transformations to *strengthen sustainability*.

More specifically, this thesis explores the fields of *planning for sea-level rise* (SLR), and *sustainable organic food systems*. While planning for SLR involves societal transformations to handle and adapt to the consequences of climate change (focus 1 of this thesis), creating sustainable organic food systems involve change through societal transformations that strengthen sustainability (focus 2). Whether in the field of planning for SLR or strengthening sustainable organic food systems, there is a shared urgency in encouraging an emergence of "truly sustainable socio-ecological relations" (Hornborg, 2009, p. 257) and in cultivating a reconnection to the biosphere (Folke et al., 2011). Raworth argues that the aim should be to stay within the "life ring", i.e. within an environmental ceiling of our only planet's ecological capacity, while firmly above a social foundation guaranteeing that everyone's human rights are met (2012). Sustainability transformations will necessitate major shifts in values and governance (Olsson et al., 2014; Westley et al., 2011), social practices (Hinrichs, 2014), and regulation of capitalism (Piketty, 2013). Not least, "we will need to harness human creativity and innovation potential to tip the interlinked social and ecological systems in the direction of greater resilience and sustainability" (Westley et al., 2011, pp. 762–763).

1.2 Aim

In light of some of the challenges outlined above, the aim of this thesis is to contribute to the understanding of emerging and crucial societal transformations towards strengthening sustainability through case studies within planning for sea-level rise (SLR) and the food system, respectively. The thesis is also aimed at identifying crucial steps forward within the two fields of planning for SLR and initiating food systems change, respectively.

1.2.1 Aims of Paper A and Paper B

In Paper A, the aim is to investigate if and how coastal municipalities in Sweden plan for future sea-level rise (SLR), by addressing the following research questions: "(1) Do the municipalities address future SLR in their planning documents? (2) If so, what levels of future SLR do they plan for? (3) What time horizons do they apply in planning for SLR? (4) How do they cope with uncertainties in projections of future SLR?" (von Oelreich et al., 2015).

In Paper B, the aim is to explore what potential influence organic initiatives aiming for a high level of sustainability (so called Organic 3.0 initiatives) can have on the global food system (characterized by a dominant corporate food regime), and also how such initiatives "can push both the organic niche and the overall food system towards sustainability transformations, and whether various initiatives differ in their potential in this regard" (von Oelreich & Milestad, 2016). Our aim is based on the assumption that individual organic initiatives may influence the organic niche and the corporate food regime differently since to different degrees they may have traits that can be attributed to more or less reformist, progressive and radical trends in the food system.

Together, Paper A and Paper B contribute to the overall aim of this thesis by increasing the understanding of societal transformations towards strengthened sustainability. They do so in exploring and analyzing actual cases within planning for SLR and the food system in relation to which the potential for emerging sustainability transformations can be discussed and discerned.

2 Research context

2.1 Strengthening societal sustainability through transformation

As outlined in the introduction to this thesis, the fundamental unsustainability of current socio-ecological relations points to a need for urgent, radical and systemic transformations towards sustainability (Olsson et al., 2014; Hinrichs, 2014). Systems change can be understood in many ways: through the lens of resilience thinking (Folke et al., 2010; Walker & Salt, 2006) or social robustness (Castell, 2010), as degrowth or *décroissance* (Latouche & Harpagès, 2010), within the framework of transitions theory (Grin et al., 2010), as a societal transition to a more sustainable and locally resilient society (Hopkins, 2008), and as requiring political change anywhere along a spectrum from gradual political reform to radical political change (Carter, 1999), including the development of new forms of "environmental citizenship" (Dobson, 2007).

Perspectives pointing to the need for a "politicisation" of the environment can be juxtaposed to theories building on the "marketisation" of sustainable development (Swyngedouw, 2015). While "green economy" theories promote concepts such as green growth, corporate social responsibility (CSR) and sustainable consumption, and highlight the market, technological solutions, "sustainable entrepreneurship" and individual consumption as solutions to environmental crises, they do not envisage a need for transformational or systemic change of current socio-ecological or socio-economic relations, thus offering a mere reformulation of capitalism (Kenis & Lievens, 2015; Swyngedouw, 2015).

As a contrast to theories of the green economy, proposing limited adjustments within the dominant paradigm, there is a wide range of theories and perspectives acknowledging the need for systemic or structural change, including (but not limited to) political ecology (Robbins, 2012), deep and social ecology (Carter, 1999), eco-feminism (Gaard, 2010) and eco-socialism (Pepper, 2003), environmental justice (Agyeman, 2014; Agyeman & Carmin, 2011), and climate justice (Timmons Roberts & Parks, 2007). Understanding of transformational change can also be discussed in terms of improved long-term thinking for *la longue durée* (cf. Braudel, 1958). The possible emergence of an "Age of Ecology" or a "Green Enlightenment" provides yet another perspective (Radkau, 2013, p. 425). It should be noted that inherently, transformations are "deeply political" (Scoones et al., 2015), as are socio-ecological and socio-economic relations (Swyngedouw, 2015). Although none of the perspectives outlined above provide a definite answer to our current predicament, they all have merit. In rejecting a narrow market perspective, and in emphasizing the political aspects of change, they provide important angles and viewpoints on the political nature of sustainability transformations. A key common denominator of these perspectives is an understanding of the imperative to strive for systemic or structural change, which is the outlook taken in this thesis.

2.2 Sustainability transformations

A main concept guiding this thesis is sustainability transformations, used interchangeably with transformations towards sustainability and societal transformations towards strengthened sustainability. As there are many interpretations and understandings of both sustainability and transformations, it is important to define how these concepts are used in this thesis.

2.2.1 Sustainability: the “safe and just space for humanity to thrive in”

As part of its 2030 Agenda for Sustainable Development, in 2015 the United Nations General Assembly adopted a number of global Sustainable Development Goals (SDGs). In total 17, the SDGs are “integrated and indivisible” and connect social, environmental and economic sustainability targets to form a “transformational vision” for the world (UNGA, 2015).

A closely related way of looking at sustainability is proposed by Kate Raworth (2012). Following Raworth’s model/visual framework (see Figure 1), in this thesis sustainability is defined as the “safe and just space for humanity to thrive in” (2012, p. 4). This space is located between social and planetary boundaries, where guaranteeing everyone’s human rights is seen as the social foundation, while collectively staying within our only planet’s ecological capacity is defined as the environmental ceiling. This sustainable space in between is also where economic sustainability can be reached. In Raworth’s model, the environmental ceiling consists of 9 elements, building on the planetary boundaries defined by Rockström et al. (2009), and ranging from climate change to biodiversity loss, land use change and chemical pollution. To these elements Raworth adds 11 social dimensions, such as water, food, health, education, gender equality and social fairness (see Figure 1). As emphasized by Raworth, humanity does not live above the social foundation today. Instead, “deep inequalities of income, gender, and power mean that millions of people are living below every dimension of the social foundation.” (2012, p. 5). Furthermore, several dimensions of the environmental ceiling have already been crossed, notably in terms of climate change and biodiversity loss (Rockström et al., 2009).

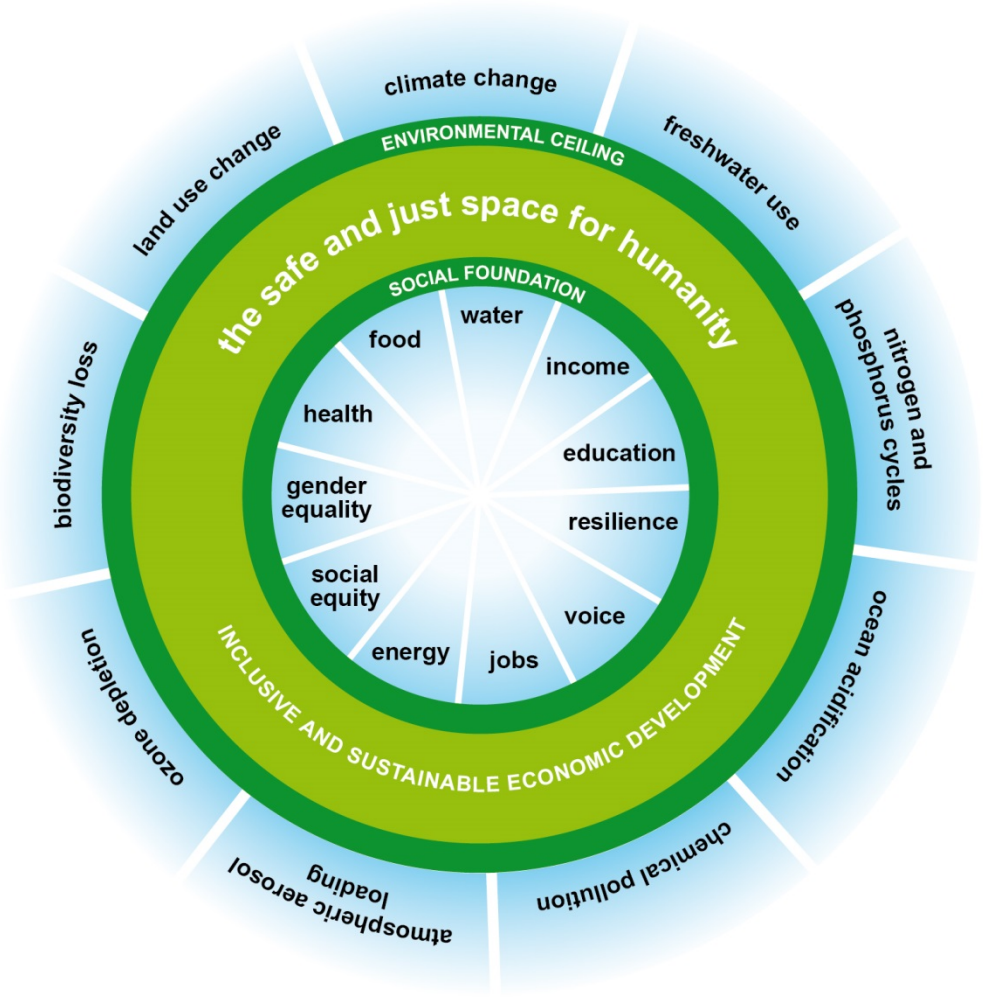

Figure 1: Kate Raworth's model for "a safe and just space for humanity to thrive in" (Raworth, 2012), the "life ring". Reproduced with permission from Oxfam.

Raworth's understanding of sustainability is shared in this thesis, since it shows that sustainability should be viewed holistically, and that guaranteeing the social foundation of sustainability should be seen as equally important as staying within the Earth's ecological capacity. In short, social and ecological sustainability are indivisible; they cannot be separated or reached without the other. Furthermore, Raworth's perspective clarifies the mismatch between on the one hand current social and ecological conditions, and on the other those required in a sustainable world. Finally, in her model Raworth connects the global social and ecological situation with every human being's human rights, and the collective efforts required to transform society in the direction of sustainability.

2.2.2 Transformations in handling climate change and transformations to strengthen sustainability

The two fields of inquiry explored in this thesis, planning for sea-level rise and sustainable food systems, share important characteristics in terms of potential transformations. Their commonalities form a metalevel framework for this thesis. Both relate to a current state, hegemonic regime or dominant paradigm that needs to be transformed towards sustainability. In the wider field of SLR, transformations may occur on several levels, both

away from a carbon based society, through *creating societal change strengthening sustainability*, but also in *handling the effects of climate change*, through adaptation. In the specific field of planning for sea-level rise, transformational change primarily involves *handling climate change*, involving change towards more robust planning approaches, since we have failed at transforming society to the extent required to prevent future SLR. In the field of sustainable organic food systems, although farming has to *handle* increasing climate disruption through adaptation, *creating change* in the food system through *strengthening sustainability* is the major concern in this paper.

Sustainability transformations can be understood as collectively moving towards the safe and just space for humanity to thrive in that is discussed by Raworth (2012), breaking with the current state, paradigm or regime (e.g. Steffen, Richardson, et al., 2015; Olsson et al., 2014). There is an extensive literature on sustainability transformations and transitions (e.g. Elzen et al., 2012; Hinrichs, 2014; Olsson et al., 2014; Seyfang & Haxeltine, 2012). The two terms overlap, and the radical and systemic nature of transformations suggested by Olsson et al. (2014) is similar to what Raskin et al. (2002), and Elzen et al. (2012) discuss as transitions. Thus, the two concepts can be used interchangeably. However, the emphasis on movement and process might be more apparent in the concept of transition, and the processes and trajectories involved in transformational change should not be lost. In this thesis, transformations are used in the plural, since transformational processes are multifaceted and involve change through "multilevel, multiphase, and cross-scale processes" (Olsson et al., 2014).

One way to understand transformations is through a multilevel perspective (MLP), which relates macro level regimes to micro level niches (Geels, 2005; Rip & Kemp, 1998; Seyfang & Haxeltine, 2012). Whereas niches offer protected spaces (2012) with alternative "social, ethical and cultural rules" (Seyfang & Smith, 2007), they are situated in a position of contestation vis-à-vis the overarching and hegemonic "rule-governed structure" of the regime (cf. Friedmann, 1993, pp. 30–31). As expressed by Seyfang & Haxeltine, an MLP tries to "capture the dialectical relationships between microlevel actors and macrolevel structures" (2012, p. 383). An MLP explains key ways in which niches can challenge and influence the regime. Notably, niche influence on the regime can take place through growth, replication, learning and questioning the regime (Seyfang & Haxeltine, 2012). As Schon points out, a challenge to a system in itself reveals the level of entrenchment of the system: "We discover the complexity and depth of a system's dynamic conservatism by seeking to change it" (Schon, 1971, p. 39).

Challenges to overturning the dominant regime can be illustrated by Unruh's (2000) discussion on the path-dependent carbon lock-in of current society. Unruh argues that currently dominating technological, organisational, institutional and social forces together form a "Techno-Institutional Complex (TIC)" (2000, p. 818) creating "policy inertia" (2000, p. 817) that in turn leads to a systemic lock-in into a fossil fuel-dependent society. Policy inertia reproduces the current fossil fuel-based system, which in turn causes climate change (2000). Escaping from lock-in demands changing the TIC through policy, which Unruh (2002) argues can be done either by measures: 1) targeting the consequences of the TIC, such as carbon emissions, "end-of-pipe" (2002, p. 318); 2) modifying parts of the complex, but retaining its overall structure, or; 3) by completely changing the complex (2002). While the two former approaches imply different degrees of "continuity" of the system, the latter demands a break with the current complex, or "discontinuity" (2002, p. 318).

Unruh's perspective can be related to regimes thinking in other areas, such as food systems studies and planning for SLR. Currently, the global food system can be characterized as dominated by the corporate food regime (Holt Giménez & Shattuck, 2011). Holt Giménez & Shattuck divide the global food system into four political food regime/food movements trends: the neoliberal and reformist trends, constituting the corporate food regime, and the progressive and radical trends, characterizing the global food movements. While aiming for no change would imply conserving the currently hegemonic corporate food regime, a reformist approach roughly overlaps with the first two strategies outlined by Unruh (2002), either treating the consequences of the system or modifying parts of it. A progressive approach demands more substantial change and a radical approach means aiming for a break with the current regime.

Keeping in mind the critical need for radical and systemic transformations towards sustainability (Olsson et al., 2014; Hinrichs, 2014), a pivotal question becomes how transformational change can be achieved. In short, how can a shift from the current regime or paradigm be facilitated, so that dominant structures are replaced with an evolving system securing a continually safer and more just "space for humanity to thrive in" (Raworth, 2012:4)? Considering the degrading environmental state of the world, including potentially devastating feedback mechanisms of the climate system, Unruh poses the questions: "at what point does a large-scale reorientation of social priorities occur?" (2002, p. 322) and "at what point does societal 'recognition' of environmental degradation lead to action?" (2002, p. 323). These questions illustrate the pivotal nature of transformational regime change. Just as there are tipping points in the Earth and climate systems (Kjellén et al., 2015; Rockström et al., 2009; Steffen et al., 2007; Westley et al., 2011), there are thresholds (Folke et al., 2010; Walker & Salt, 2006) or tipping points in socio-ecological systems (Westley et al. 2011). Although it is uncertain whether catastrophic "focusing events" (Unruh, 2002, p. 323) caused by climate change will be necessary to bring about transformational social action to end carbon lock-in, Unruh (2002) argues that looking at historical precedents, it is apparent that social movements, among them environmental movements, have been primary sources pushing transformational change, a perspective shared by Holt Giménez & Shattuck (2011).

2.2.3 Handling climate change and future sea-level rise under deep uncertainty

In Paper A (von Oelreich et al., 2015), on which this section is partly based, we present an overview of current knowledge on sea-level rise (SLR), linked to perspectives on planning. The text below is partly based on that review, originally compiled mainly by my paper co-author Wikman-Svahn, but updated to reflect more recent findings.

As discussed in von Oelreich et al. (2015), uncertainty is a defining feature in relation to future SLR. Our predicament can be described as a situation of "deep uncertainty … in which analysts do not know or cannot agree" (Hallegatte et al., 2012). This deep uncertainty is exacerbated by the long-term perspectives inherent in processes of climate change, limitations in climate models as well as "a lack of a complete understanding of all the processes involved in the real climate" (Ranger et al., 2013, p. 236).

A rapidly warming climate and subsequent SLR challenges planning authorities and puts pressure on affected municipalities to engage in substantial adaptation efforts (e.g. Glaas et al., 2010; Aal et al., 2012). Climate change, including disruptive and irreversible sea-level rise is already 'in the pipe-line'. In this context, the scale of change facing the Earth system in terms of climate change and SLR should be put in a long-term temporal perspective. As expressed by Zeebe et al., the "massive" (2016, p. 1) rate of carbon release into the

atmosphere that we are experiencing today represents a “no-analogue state” for the Earth system (2016, p. 4), without precedent for at least 66 million years. This implies that “unforeseeable future responses of the climate system are possible” (2016, p. 1), indicating a wide range of uncertainty also in terms of future SLR.

In short, while it is certain that future sea levels will rise as a consequence of a changing climate, the answers to the crucial questions *how much?* and *when?* are uncertain – i.e. both the scale and speed of future SLR is uncertain (Willis & Church, 2012). Furthermore, regional variations in SLR should also be taken into account (Mitrovica et al., 2009).

Currently, the rate of SLR is faster than at any point in the past 27 centuries (Kopp et al., 2016). Most estimates of future SLR focus on the end of the twenty-first century, as compared to the end of the twentieth century. The Intergovernmental Panel on Climate Change (IPCC) in its fourth assessment report proposed a range of global mean SLR of between 0.18 and 0.59 m for the end of the twenty-first century (IPCC, 2007). This estimated range was updated to 0.28–0.98 m global mean SLR for different scenarios in the 2013 fifth assessment report of the IPCC (Church et al., 2013), to reflect more recent findings. However, this does not account for Antarctic ice sheet collapse, and as argued by Levermann, lead author of the chapter on sea level change in the fifth assessment report (Church et al., 2013), “the upper value of the likely range” is between 1.2 and 1.5 metres. Thus, Levermann argues that this “is the upper limit of global mean sea level that coastal protection might need for the coming century” (Yale Environment 360, 2013).

Recent research has highlighted the risk of accelerated and long-term SLR (cf. von Oelreich et al., 2015), which is closely linked to the significant loss of ice from the large ice sheets in Antarctica and Greenland observed over the decades straddling the turn of the century (Shepherd et al., 2012). As pointed out in von Oelreich et al. (2015), the risk of an acceleration in SLR is also linked to the continued increase in anthropogenic GHG emissions, which amounts to a considerable challenge in terms of mitigating climate change (International Energy Agency, 2013). Consequently, more consideration has been given to scenarios acknowledging high-end global warming and SLR (Nicholls et al., 2011). Furthermore, within the research community there is an improved understanding that sea levels will most likely continue to rise for many centuries to come, even if significant measures are implemented to mitigate climate change (Meehl et al., 2012). Recent assessments indicate that SLR of up to 2 m by 2100 is possible (Nicholls et al., 2011; Parris et al., 2012). Other assessments suggest even higher levels (Hansen & Sato, 2012; Lowe et al., 2009; Tol et al., 2006). Jevrejeva, Grinsted, & Moore (2014) estimate an upper limit for SLR projections by 2100 at 1.9 m. However, they argue that “large uncertainties remain”, indicating that higher SLR is possible (2014, p. 1).

Recent findings have highlighted that future SLR might become worse than previously expected, emphasizing the importance of taking worst-case scenarios into account in planning. These findings to a large extent are related to research on the cryosphere (ice sheets and glaciers). Kjellén et al. (2015) argue that we are approaching irreversibility in relation to the melting of the great ice sheets of Greenland and Antarctica, risking “an ultimate sea-level rise of between 4–10 meters or more” (2015, p. v). Recent studies of the potential collapse of the West Antarctic ice sheet show that in a worst-case scenario 4 m will be added to global SLR over the coming 200 years, but that it might take 900 years. While early-stage collapse of the West Antarctic ice sheet has begun and is inevitable, the timing is thus uncertain (Joughin et al., 2014). DeConto and Pollard show that Antarctica alone, through its melting ice sheets, “has the potential to contribute more than a metre of

sea-level rise by 2100 and more than 15 metres by 2500, if emissions continue unabated" (2016, p. 591). A major conclusion drawn by DeConto and Pollard is that "long-term commitment to elevated sea level" is already inevitable (2016, p. 596). Whereas knowledge of how high sea levels can ultimately rise is crucial, knowledge about the speed and timing of SLR might be even more pertinent in terms of societal planning. Hansen et al. argue that if the increase in GHG emissions continues, SLR of several metres "would become practically unavoidable, probably within 50–150 years" (2016, p. 3799).

While most projections for future SLR take aim at the late twenty-first century, projections with a focus beyond 2100 have also been published. In its fifth assessment report, the IPCC (Church et al., 2013) indicates that under a high-emissions scenario, SLR might amount to up to 6.6 m 500 years from now. Other studies found that even under a low-emissions scenario, sea levels could rise 1–3 m by 2300 (Schaeffer et al., 2012). Jevrejeva et al. concluded that a high emissions scenario could result in seas rising 2–12 m by 2500 (2012). Analogies with paleoclimatic history suggest an even higher rise in sea levels when looking towards time horizons even further into the future. Historically, the contemporary concentration of atmospheric carbon dioxide (i.e. around 400 ppm) has been linked to sea levels 9–31 m above present (Foster & Rohling, 2013). In addition to levels *per se*, future "superstorms" (Hansen et al., 2016) should be taken into account, as they will increase the impact of future SLR.

As discussed in von Oelreich et al. (2015), different ranges for future SLR have been proposed in various national assessments, with estimates ranging from 0.55–1.10 m by 2100 for the Netherlands (Deltacommissie, 2008) to 2.5 m by 2100 for the United Kingdom (Lowe et al., 2009). In Sweden, "around one metre" is often used as an unofficial estimate (von Oelreich et al., 2015), which is roughly in line with IPCC conclusions, and which in light of other assessments and studies can be considered 'conservative'. As a contrast, the analysis of Hansen et al. (2016) "paints a very different picture than IPCC (2013) … if GHG emissions continue to grow" (2016, p. 3799).

As Adger et al. (2006) argue, in addition to taking action to avert further climate change and its disastrous consequences, adapting to already inevitable effects of climate change is imperative. Planning for SLR that strengthens adaptation to rising sea levels is crucial, not least considering that the world's major population centres are located along the world's coastlines. More than 600 million people live in low elevation coastal areas less than 10 m above sea level (McGranahan et al., 2007). However, different populations are not equally vulnerable to climate impacts, and thus adaptation requires building on climate policies ensuring a fair outcome of adaptation measures (Adger et al., 2006). In assessing the current global state of adaptation, the fifth assessment report of the IPCC (Mimura et al., 2014) concludes that we have entered a period of transition, moving "from a phase of awareness to the construction of actual strategies and plans in societies" (2014, p. 871). Strategic planning is indispensable at the national level, while local planning actors often lack access to local data and the capacity to manage complexities. This testifies to the importance of connections between national strategies and planning at subnational and local levels (2014).

As mentioned in von Oelreich et al. (2015), significant differences between adaptation measures relating to SLR can be discerned between different countries, regions and local authorities (Nicholls & de la Vega-Leinert, 2008; von Oelreich et al., 2015; Wilby & Keenan, 2012). Who takes the main responsibility for planning for SLR differs between all levels of government (Tol et al., 2008). While the national government takes main

responsibility for coastal defence in the Netherlands (van Koningsveld et al., 2008), in Germany the main responsibility lies with state governments (Sterr, 2008) and in Ireland with the counties (Devoy, 2008).

In Sweden, municipalities are responsible for spatial planning (SKL, 2016). As emphasized in von Oelreich et al. (2015), decisions taken by Swedish municipalities in relation to coastal planning depend on assumptions about the extent and speed of future SLR. Planning for SLR is an issue municipalities in Sweden need to deal with (Carlsson-Kanyama et al., 2013). However, in terms of coastal zone management, there is a lack of continuity in policymaking, planning and decision-making (Storbjörk & Hedrén, 2011). Consequently, improved planning, decision-making and regulation is needed (2011). Including social values when considering the impact of SLR is also crucial (Graham et al., 2013).

Adaptation to SLR demands applying long-term time frames. It also involves handling uncertainties in terms of how rapidly sea levels will rise, as well as by how much (cf. von Oelreich et al., 2015). Local planners must handle such uncertainties, and take them into account when planning for new dwellings, infrastructure or freshwater provisioning along coastlines (2015). While SLR and climate change in general are global phenomena, they have local impacts. Thus, managing them often needs to be done locally. However, as Tol et al. point out, to a large extent we lack empirical knowledge of how handling SLR is done in practice (2008). In Paper A of this thesis, we explore how municipalities use "assumed levels and timeframes for future SLR in spatial planning" (von Oelreich et al., 2015), which Hurlimann and March (2012) identify as key to climate change adaptation. As we point out in our paper, the increasing risk of accelerating and long-term SLR explains the particular importance of assessing assumed levels and timeframes for future SLR (von Oelreich et al., 2015).

2.2.4 Creating social change in the food system: from unsustainability to sustainability

As outlined in Paper B (von Oelreich & Milestad, 2016), on which this section is partly based, the current global food system is deeply unsustainable and in need of transformations to sustainability (Foley et al., 2011; Hinrichs, 2014). The global food system faces a 'quadruple squeeze' from anthropogenic climate change, increased population and development pressures, ecosystem crises and the risk of transgressing the safe operating space of the Earth system (Rockström & Karlberg, 2010). The requirement for a sustainable food system that meets the dietary needs of the world's population will not be met by business-as-usual production in industrialised agriculture (IAASTD, 2008).

Industrialised or conventional agriculture dominates the current global food system, and while it has brought substantial increases in production especially since the mid-twentieth century, production is currently plateauing, and the negative socio-ecological impacts of industrial agriculture are significant and systematic (IPES-Food, 2016). The high input-intensity, monocultures and concentration of livestock characterizing specialised industrial agriculture leads to lack of resilience, food insecurity and severe vulnerabilities. The detrimental socio-ecological outcomes of conventional agriculture involve land degradation, water stress, ecosystem destruction, biodiversity loss and GHG emissions. Furthermore, the industrial food system is linked to significant social consequences such as food crisis, severe pressure on farmers worldwide and power concentration (Holt Giménez & Shattuck, 2011; IPES-Food, 2016).

It has been argued that without the productivity increases of industrialised agriculture, significantly more land would have been needed to supply the same output, thus resulting in considerable deforestation (e.g. Burney et al., 2010). However, this argument disregards that in a parallel process over recent decades agricultural land has been increasingly used for meat and animal foods production. The dominant and global dietary transition over recent decades (although not encompassing everyone), from "largely vegetarian to fairly meaty diets", has resulted in a significant increase in demand for animal feed (Smil, 2000, p. 11). Even a moderate dietary transition, involving the move from a diet where 10 percent of food energy is derived from animal foods to one in which 25 percent of food energy comes from animal foods, results in the need for crop harvests twice as big in the latter case as in the former (2000). This exemplifies the impact of moving from a largely vegetarian diet to one dominated by animal foods, and vice versa.

In a report aimed at assessing "the full impact of the livestock sector on environmental problems", the FAO (2006, p. xx) concludes that the livestock sector far exceeds any other economic sector in terms of land use, directly utilizing more than a quarter of ice-free land and relying on a third of all arable land for animal feed production. Recent deforestation and land degradation, with more than a fifth of land on Earth currently degraded (UNCCD, 2012), is largely driven by meat production (FAO, 2006). In terms of GHG emissions, livestock production alone stands for 18 percent of emissions, as measured in CO_2 equivalents (FAO, 2006). In total, the global food system stands for around a third of all human-induced GHG emissions (Thornton, 2012).

Not only meat production, but also the monoculture practices characterizing specialised conventional agriculture, such as industrial palm-oil plantations (Vijay et al., 2016), result in deforestation, which leads to carbon emissions and increases the risk of soil erosion, as well as soil and water contamination (Boardman et al., 2003). Manure, antibiotics, chemicals and hormones are further direct causes of water pollution from livestock production (FAO, 2006), while fertilizers and pesticides from both meat production and other forms of industrialised agriculture pollute water and land (Parris, 2011). Intensive (especially non-organic) meat and animal foods production is linked to heavy use of antibiotics, resulting in increasing antimicrobial resistance, also severely threatening human health (CDDEP, 2015).

The use of fertilizers within industrialised agriculture causes dependency on mined phosphorus, which is a non-renewable resource that may become depleted in 50–100 years (Cordell et al., 2009). In turn, excessive fertilizer use leads to nutrient pollution, which together with pesticide use has resulted in eutrophication and numerous and exponentially expanding "dead zones", reported from more than 400 marine ecosystems worldwide (Diaz & Rosenberg, 2008). Among such dead zones in the world's oceans are the Bay of Bengal (Bristow et al., 2016) and parts of the Baltic Sea (Diaz & Rosenberg, 2008; HELCOM, 2015). In addition to water pollution, industrialised agriculture in many parts of the world depends on mining of groundwater reserves at rates that are not naturally replenishable, e.g. in India (Rodell et al., 2009) and the United States (Scanlon et al., 2012).

Furthermore, "industrial agriculture significantly reduces agrobiodiversity by employing a reduced range of animal breeds and plant varieties", leading to genetic erosion (IPES-food, 2016, p. 21). Conventional agriculture not only depletes agrobiodiversity, but also destroys habitats and biodiversity of wild ecosystems (Wood et al., 2000). Globally, biodiversity loss

is one of two fields, together with nitrogen flows, where we have moved furthest beyond the Earth system's "safe operating space" (Steffen et al., 2015).

As a reaction to conventional industrialised agriculture and its detrimental socio-ecological consequences, organic farming practices have developed over the past century, challenging mainstream conventional agriculture and the dominant food regime (Allen & Kovach, 2000; Dantsi et al., 2009; Goldberger, 2011). The first wave of organic farming, 'Organic 1.0', was driven by organic pioneers and emerged about a century ago. After about half a century, from the 1970s and onwards, this initial wave of organic farming led on to the emergence of a common organic movement. This movement, 'Organic 2.0', currently forms the organic mainstream and it is characterized by reliance on organic standards and certification. It constitutes a niche in the overall food system, setting it apart from conventional agriculture. In turn, the Organic 2.0 niche is growing and diversifying. Organic 2.0 is currently challenged by 'Organic 3.0' which aims for a new level of sustainability, complementing previous organic approaches with a stronger focus on systemic change in terms of health, ecology, fairness and care (Arbenz et al., 2015; Gould, 2015), a focus shared with diversified agroecological farming (IPES-food, 2016).

Thus, the logic of industrialised agriculture can be contrasted with that of 'diversified agroecological systems' (IPES-food, 2016), which share key characteristics with 'Organic 3.0' agriculture (Arbenz et al., 2015; Gould, 2015). Diversified agroecological and Organic 3.0 systems share a holistic and systemic aim, directed at long-term sustainability in terms of agroecology, biodiversity, health, fertility, fairness, care, as well as secure livelihoods (Arbenz et al., 2015; Gould, 2015; IPES-food, 2016).

Diversified agroecological and Organic 3.0 systems perform better than conventional industrial agriculture in terms of socio-ecological outcomes. In terms of productivity, although organic farming is slightly less productive in developed countries (8% lower yields), it is much more productive in developing countries (80% higher yields) (Badgley et al., 2007). Crucially, the long-term stability over time (i.e. over more than a century) and the resilience of diversified agroecological systems is higher, in terms of productivity and output (IPES-food, 2016). A high degree of diversity within agroecological systems cultivates socio-ecological resilience, reduces risk and facilitates climate adaptation through a range of interlinked strategies such as "the protection and restoration of ecosystems, the sustainable use of soil and water resources, agro-forestry, diversification of farming systems, various adjustments in cultivation practices and the use of stress-tolerant crops and crop improvement" (Mijatović et al., 2013, p. 95). However, it is worth noting that Paper B is not aimed at evaluating organic, Organic 3.0 or diversified agroecological farming systems, but to assess what potential influence organic initiatives aiming for a high level of sustainability (so called Organic 3.0 initiatives) can have on the overall global food system (von Oelreich & Milestad, 2016).

While alternative food practices are emerging within the global food system (Davidson, Jones & Parkins, 2016), it is currently dominated by the corporate food regime, counteracting the growth of alternative food movements (Holt Giménez & Shattuck, 2011). A food regime, according to Friedmann (1993, pp. 30–31), is a "rule-governed structure of production and consumption of food on a world scale", i.e. a global system of food trade relations reflecting inequalities in economic and political power (cf. McMichael, 2014). The corporate food regime is characterized by neoliberalism, concentration of ownership, "monopolized market power", and causes widespread socio-ecological destruction (McMichael, 2014, p. 41). A number of "lock-ins" prevent alternatives from replacing

industrialised agriculture, amounting to barriers in terms of not only path dependencies, but also export orientation policies, lack of long-term perspectives, market power concentration and "compartmentalized thinking" (IPES-Food, 2016, p. 51).

Organic food systems differ in terms of distance from the corporate food regime. While Organic 2.0 corresponds to mainstream certified organics represented within the neoliberal and reformist trends of the current food regime, Organic 3.0 and diversified agroecological farming systems are closely related to the progressive and radical trends within the global food system (Holt Giménez & Shattuck, 2011), sharing an aim for a "metamorphosis" (Gould, 2015, p. 140) of the organic approach and the food system as a whole. A multitude of Organic 3.0 initiatives, part of wider food movements to varying degrees, and embedded within the social economy (Seyfang & Smith, 2007), challenge the regime. In this context, Organic 3.0 can be seen as a 'niche within a niche'.

In exploring possibilities for transformation, it is important to acknowledge what Seyfang & Haxeltine term the "dialectical relationships" (2012, p. 383) between niches and regime. To understand societal transformations, we need to understand how change can be initiated within niches, what barriers the regime imposes on emerging niche transformations, and how these obstacles can be overcome. Holt Giménez & Shattuck discuss the dialectics of niche-regime relationships in dividing the global food system into four political trends, where the neoliberal and reformist trends dominate, but where progressive and radical food movements challenge the current global food regime (2011).

At present, organic farming constitutes a small but growing niche (Willer & Lernoud, 2015), whose relationship to the regime is characterized by contestation (Seyfang & Haxeltine, 2012). A largely unexplored question is to what extent Organic 3.0 initiatives can challenge the corporate food regime, and how they can push the organic niche and the food system towards sustainability transformations. What is clear is that change through sustainability transformations has to be multifaceted. In addition to major shifts in social practices, institutions (Westley et al., 2011), values, and governance (Olsson et al., 2014; Raskin et al., 2002), there is a need for social learning (Clark, 2001) and for a shift in understanding, an "epistemic reorientation" (McMichael, 2011, p. 804), from perceiving agriculture as a commercial and technological endeavour based on the domination of nature, to revaluing farming as the ecologically embedded underpinning of human civilisation (2011). The degree to which transformations within the food system are possible depends on the relative strength of the four trends discussed by Holt Giménez & Shattuck; to successfully bring about change, the progressive and radical trends within the global food movement should join together as a social force, forge "strategic alliances" and aim for clear political targets (2011, p. 136).

To contribute to transformations towards a sustainable food system, the Organic 3.0 niche has to influence both the wider organic niche and the regime. Gould describes this transformational development as turning organic farming into "the mainstream choice for agriculture (…) but also its leading edge" (2015, p. 137), thus transforming the regime towards organic, while at the same time transforming Organic 2.0 towards Organic 3.0. In this multifaceted, multi-level process, we move from the niche level to the level of the individual Organic 3.0 initiative, since these initiatives can be seen as the actors within the niche. Holt Giménez & Shattuck (2011) argue that only through linking up to the joint social movements of progressive and radical initiatives, individual initiatives can exert meaningful (joint) pressure on the regime. In other words, the transformational potential of an individual initiative depends on the approach it takes.

In turn, food systems change towards sustainability requires that actors within and beyond the system *initiate* and *create* change, not least through social innovation (Marsden, 2013). Transformational change builds on "multilevel, multiphase, and cross-scale processes" (Olsson et al., 2014) and such processes can be explored through a multilevel perspective (MLP), relating macro level regimes to micro level niches. When exploring how to bring about societal transformations strengthening sustainability in the food system, it is important to identify where such change can emerge, who can initiate it, and what are the barriers to change. An MLP is useful in identifying key actors, spaces, and conditions that are conducive to change, and also what obstacles prevent transformations. Niches offer protected spaces where change can be initiated (Seyfang & Haxeltine, 2012), and provide places with alternative "social, ethical and cultural rules" (Seyfang & Smith, 2007).

The extent to which Organic 3.0 niche initiatives are successful in growing, multiplying, or questioning the existence of the regime (Seyfang & Haxeltine, 2012) may depend on the extent to which they exhibit reformist, progressive and radical traits. Assessing the degree to which Organic 3.0 initiatives relate to reformist, progressive and radical trends can thus help us explore their potential to influence the corporate food regime and contribute to transformations towards a sustainable food system. In Paper B of this thesis, we depart from the assumption that individual Organic 3.0 food initiatives may have different potential to influence the corporate food regime.

2.2.5 Handling change and creating change

From the review presented in the two preceding sections, it is apparent that transformational change towards sustainability builds on different strategies in different fields. Whereas in planning for SLR the emphasis lies on *handling* and *adapting to* one of the major impacts of climate change, rising sea levels, under conditions of uncertainty, the focus within food systems change lies on *creating* sustainable alternatives that can build strengthened sustainability through challenging the dominant regime.

3 Methods and methodology

3.1 Methods

The presentation given below, of the empirical methods that are used in the papers included in this thesis, is based upon the methods sections of Paper A (von Oelreich et al., 2015) and Paper B (von Oelreich & Milestad, 2016). For a full description of methodology, please see the respective papers included in this thesis.

In Paper A, we used two main methods: qualitative interviews and a document survey, while in Paper B we used qualitative interviews and analysis of core documents and web pages. In both cases, the interviews were performed in a semi-structured way (Kvale, 2007), where we departed from an interview guide. For both papers, the interviews were recorded and transcribed, then analysed thematically (Miles & Huberman, 1994), except for the two final interviews conducted for Paper B, when we took notes.

For both papers, as a first step we identified key respondents to interview. In Paper A these consisted of people responsible for planning for SLR within local, regional and national authorities, as well as a planning consultancy working with local governments, while in Paper B they consisted of people with key roles within our two case studies, Ekolådan (EL) and Upplandsbondens (UB). While we conducted 12 interviews with the same number of

respondents for Paper A, we conducted 15 interviews with 9 respondents for Paper B. In the latter case, we employed a snowball sampling technique to identify further interviewees after having identified a number of central respondents (Biernacki & Waldorf, 1981).

A survey of municipal planning documents dealing with SLR made up a significant part of the methods used for Paper A. In Paper B, we analysed core documents and web pages linked to our two case studies, but methodologically this analysis was more limited than the document survey conducted for Paper A. In Paper A we surveyed the websites of 33 coastal municipalities in southern Sweden and analysed the documents we identified as guiding in terms of planning for SLR. These documents mainly consisted of municipal comprehensive plans, climate and vulnerability analyses, climate strategies and climate memoranda. These documents were analysed thematically, together with the findings from our interviews, in relation to: 1) what planning documents on SLR existed, 2) what estimates of future SLR they contained, 3) what time horizon for SLR they planned for, and 4) what original source for estimates of future SLR they departed from. We entered the thematic analysis into a database.

In Paper B, our document analysis was more limited. We explored key founding, administrative and financial documents, as well as the webpages, of our two case studies. As in the case of Paper A, also in Paper B we analysed the empirical material collected in interviews and documents together, in the latter case for the presence of main features of the food regime/food movement trends proposed by Holt Giménez & Shattuck (2011). To assess what food regime/food movement trends the studied initiatives could be attributed to, our analysis considered: 1) the basic orientation of the initiatives, 2) the beneficiaries, 3) the geographical scope, 4) the solutions they provide, and 5) the types of food they advocate. To explore their transformational potential, we analysed the initiatives in relation to key ways in which niches can influence a regime, i.e. through: 1) growth, 2) replication, 3) learning, and 4) questioning the regime (cf. Seyfang & Haxeltine, 2012).

3.2 Methodological reflections

In both papers, methodology could have been improved in various ways, e.g. through the study of more cases, and through additional and deeper interviews. In Paper A, it would have been preferable to study more coastal municipalities, since municipal planning was only assessed for part of Sweden's coastline. Especially, it would be preferable to cover also the bigger cities in Sweden, where a major part of the population lives. Interviewing not only planners but also politicians would have added to the study, as planning decisions are taken by politicians. In Paper B, studying additional cases of organic food initiatives would have improved the study. Although the findings presented in the two papers are limited to what we in fact studied, putting the results from the two papers in a larger theoretical context of sustainability transformations allows us to bring the discussion of some of the findings to a higher level.

As this thesis is a licentiate thesis, it is worth pointing out that it is an *essai* in the literal sense of the word, an *attempt* at attaining some understanding along the pathway of doctoral studies, at finding methodological meaning while standing on a "melting, drifting ice floe" (Metzger, 2014), in the midst of flux (cf. Law, 2004). As Alvesson & Sköldberg emphasize, reflexive research should give "opportunities for understanding", rather than establishing "truths" (2009, p. 9). This is what I aim for in this thesis. And as pointed out by Law, method is "performative", it produces political realities, and it is not "innocent or purely technical" (2004, p. 143). There is always a choice involved in what questions, answers, methods, perspectives and realities we choose and want to produce and highlight.

However, as Law concludes, rather than disengagement, we should strive for an awareness of "how to engage" and we should strive to "make good differences" (2004, p. 7). I see this thesis as a way of engaging in work contributing to the discussion on sustainability, and my hope is in some way to contribute to making such good differences, towards sustainability transformations. However, there is no objective or "undisputable public good" (Rittel & Webber, 1973, p. 155), and thus there are no definite answers to questions of what "good" research or differences are. Likewise, there is no "neutral, apolitical, ideology-free space" in which research can be conducted (Alvesson & Sköldberg, 2009, p. 12). Thus I also want to be clear that what this thesis is aimed at is contributing to sustainability transformations, which I see as essential in a world currently characterized by deep unsustainability.

4 Results

The text in this section is based upon Paper A (von Oelreich et al., 2015) and Paper B (von Oelreich & Milestad, 2016).

4.1 Paper A: Planning for future sea-level rise in Swedish municipalities

In Paper A we assessed the state of planning for future sea-level rise in Sweden through a survey of planning documents in 33 coastal municipalities in southern Sweden and interviews with local, regional and national authorities accountable for SLR planning.

The results from our study revealed that there are significant weaknesses in how the studied municipalities currently plan for SLR. Guiding planning documents for SLR are missing in almost a third of the studied municipalities and more than two-thirds of municipalities lack planning for SLR beyond 2100. Furthermore, we identified a perceived lack of knowledge about SLR among the studied municipalities, who expressed a wish for improved guidance on what future sea levels to plan for.

Our paper showed that as knowledge increases of the long-term consequences of current climate change processes, in terms of sea levels rising at an increasing rate for centuries or millennia to come, planners increasingly need to take accelerating and long-term SLR into account. At the same time, planners dealing with the coastal zone must consider the uncertainties and ambiguities in current knowledge of how fast and how much SLR will occur. While taking uncertainty into account, planners should nevertheless strive to take action also before uncertainty has been reduced.

We concluded that society needs to strive for adaptation and preparedness through robust planning approaches, despite current uncertainties in relation to how fast and substantial future SLR will be. Within a traditionally dominant "predict-then-act" paradigm, the prevailing uncertainties and ambiguities in estimates for future SLR are problematic. However, moving from this paradigm towards robust approaches (Weaver et al., 2013), such as scenario planning (van der Heijden, 2005), may improve local planning for SLR by reducing the problems inherent in the prevailing planning paradigm. Robust planning approaches are aimed at handling diverse and uncertain outcomes. Often, robust planning strategies depart from a specific decision-making context, involving participatory capacity-building processes. Furthermore, a key strength of robust approaches is that they seek solutions that are adequate not only for a single projection but for a wide range of possible scenarios (see e.g. Hallegatte, 2009, and Hallegatte et al., 2012 for recent reviews). When planning for future SLR, it is more fruitful to work with a broad range of possible

scenarios, rather than a "likely" or central estimate. Furthermore, robust approaches give more consideration to high-end scenarios and extreme cases.

4.2 Paper B: Sustainability transformations in the balance: Exploring Swedish initiatives challenging the corporate food regime

Paper B is set in the context of a global food system failing profoundly in meeting core sustainability challenges (Hinrichs, 2014). In the paper we explored to what extent organic food initiatives that go beyond mainstream organic, towards Organic 3.0 (Gould, 2015), can challenge the corporate food regime. In turn, we assessed how such initiatives can push the food system in the direction of sustainability transformations.

The results from our study indicated that the relations between the two explored initiatives, EL and UB, and the corporate food regime share key characteristics, but also differ in important respects. Both initiatives function as alternatives to the dominant regime, spurring social innovation, but in different ways. While EL has built a separate system based on social concerns all the way from producer to consumer, UB farmers pioneered organic meat production in their region and their cooperative has managed to improve social conditions for its members, through increased prices. While EL and its parent foundation, BP, follow a progressive and partly radical approach and have kept their values over time, UB mostly follows a reformist approach based on mainstreaming, but with some progressive and radical traits. UB farmers have had to partly compromise their own values to reach profitability, in trying simultaneously to follow reformist and (their preferred) progressive approaches. Thus, UB can be said to use a mainstreaming approach to achieve a progressive aim.

The food regime/food movements framework proposed by Holt Giménez & Shattuck (2011) provides analytical clarity and paints an overarching picture of the global food system and its contestations. However, its simplified representation of the food system obscures some of its complexities. Both EL and UB show traits of several food system trends, but UB provides the clearest example of hybridity in straddling the reformist-progressive divide, showing that organic initiatives cannot be ascribed only to one trend in the food system (cf. Holt Giménez & Shattuck, 2011). Through their emphasis on a wider understanding of organic food, both EL and UB approach Organic 3.0, which overlaps with the progressive and radical trends in the food system (cf. Gould, 2015; Holt Giménez & Shattuck, 2011). From this perspective, they can be seen as part of a 'niche within the niche' of organic food production in Sweden. As pointed out by Marsden, "social and governance innovation" in food system niches challenging the mainstream "may be crucial for regime change" (2013, p. 124). In addition to innovativeness, in order to succeed transitional processes also need to result in "persistent" niche creation (van der Ploeg et al., 2004, p. 10).

In Paper B, we discussed to what extent EL and UB have contributed to enduring Organic 3.0 niche creation, in the context of niche impact on the regime, which can take the form of niche growth, replication, learning and questioning the regime (Seyfang & Haxeltine, 2012). Regarding niche growth, the trajectories of EL and UB differ. So far, the transformational impact of UB can be seen as limited, while EL, on the other hand, has managed to consolidate its 'niche within a niche' existence, but on a more modest scale. As models of inspiration, both EL and UB might induce food systems change through replication (Seyfang & Haxeltine, 2012).

Both EL and UB have had an impact on the organic niche and the food regime. EL represents an alternative approach, although limited in scale, questioning both Organic 2.0 and the regime. UB has widened consumer access to organic products through its growth, but translation of Organic 3.0 values into the wider organic niche and the regime has been limited. This means that linking Organic 3.0 values to the wider niche and the overarching regime remains a challenge. In the case of EL, its separate system approach does not link up with the niche or regime, and in the case of UB, while promoting organic production, its Organic 3.0 values are masked by interaction with the mainstream. A key conclusion from Paper B is that one of the main roles of Organic 3.0 initiatives may lie in illustrating the viability of alternative food systems models.

5 Concluding discussion

The main conclusions from the results of Paper A were that there are serious weaknesses in how Swedish municipalities currently plan for SLR. A significant share of the studied municipalities did not cover planning for SLR in municipal planning documents, and a large majority did not take SLR beyond 2100 into account. Furthermore, we identified a perceived lack of knowledge about SLR among the studied municipalities, who expressed a wish for improved guidance on what future sea levels to plan for. We concluded that the large uncertainties and ambiguities involved in assessing future SLR are more problematic within a traditionally prevailing "predict-then-act" paradigm, and that letting robust approaches such as scenario planning guide local planning for future SLR may reduce these challenges.

In Paper B, main conclusions were that Organic 3.0 initiatives need to persistently pursue Organic 3.0 and its interpretation of sustainability in order to build a solid sub-niche that can push the wider organic niche and the overall food system towards sustainability transformations. Furthermore, moving towards Organic 3.0 requires initiatives to maintain and deepen the edge of organic, while simultaneously translating innovative social practices and values into the food regime. We also concluded that one of the key roles of Organic 3.0 initiatives may lie in illustrating the viability of alternative food systems models.

The two papers included in this thesis show that the sustainability transformations needed within the global food system and in planning for SLR are different, but that they also share common challenges. In both fields, sustainability transformations require a move away from "business as usual", transcending a currently dominant conventional food regime, and a conservative paradigm for planning for SLR, which does not take worst-case scenarios into account. In both fields, it is crucial to move towards the recognition and expansion of innovative approaches and perspectives. In the food system, there is a need for moving beyond the hegemonic food regime towards creating a sustainable food system (Hinrichs, 2014; Holt Giménez & Shattuck, 2011; McMichael, 2014). In planning for SLR, handling SLR may be facilitated through transcending the traditional "predict-then-act" paradigm, and approaching SLR with robust planning under uncertainty (Weaver et al., 2013). Both fields can thus be seen from a niche-regime perspective, where an emerging niche in perspectives or practices (or both) may grow and transfer innovative knowledge to the overall regime.

Within transitions theory, the multilevel perspective (MLP) explains possibilities for change through the interactions between the landscape, regime and niche levels (Darnhofer, 2015). Analysis of all three levels is required to reach understanding of the potential for change. In terms of food systems change, the surrounding landscape is characterized by climate change, environmental degradation and food insecurity (Marsden, 2013; van der Ploeg et al., 2004), while we can think of the landscape surrounding planning for SLR as dominated by concerns about the former, i.e. climate disruption. In both cases, a prevailing regime is dominant. In the food system, industrialised agriculture forms the regime, while in planning for SLR, the regime can be understood as a traditional or conservative paradigm, excluding high-end scenarios from planning theory and practice. From this perspective, alternative food initiatives such as Organic 3.0 form niches within the global food system, while dynamically robust planning practices considering also worst-case scenarios forms a niche within the context of planning for SLR.

A key feature distinguishing planning for sea-level rise from building sustainable food systems involves uncertainty. As highlighted by Ranger, Reeder & Lowe, a considerable challenge in planning for SLR is that "projections of future climate are deeply uncertain" (2013, p. 233). Recent developments of a variety of decision-making strategies facilitate the management of scientific predictions characterized by ambiguity and uncertainty, especially in relation to climate change. These developments involve a move towards "robust approaches", and simultaneously a movement away from a traditional "predict-then-act" paradigm (Weaver et al. 2013). An advantage of robust approaches is that they are designed to handle outcomes of an uncertain and diverse nature. Furthermore, such approaches often depart from a specific context of decision-making. The focus of robust approaches lies on finding solutions that work not only for a single projection, but across a broad range of possible futures scenarios (cf. Hallegette, 2009; Hallegatte et al., 2012).

Planners at different levels, both within municipalities and elsewhere, may find robust approaches useful. Robust strategies can improve how we manage uncertainty in relation to future SLR. As discussed by van der Heijden (2005), scenario planning amounts to a robust approach that is useful when societies need to prepare and plan for a broad spectrum of possibilities (Bell, 2003). "Dynamic robustness" is a related approach, based on building "flexible strategies that can be changed over time as more is learnt or as conditions change" (Ranger et al., 2013, p. 233). Translating Unruh (2000; 2002) to the field of planning for SLR, policy inertia can be discerned in continuing reliance on a conservative paradigm, "business as usual", or a traditional "predict-then-act" paradigm, while "discontinuity" would imply e.g. a move towards more dynamically robust or resilient planning approaches (cf. von Oelreich et al., 2015; Weaver et al., 2013).

The uncertainties involved in societal transformations aimed at strengthening the sustainability of the food system are of a different kind than those challenging the field of planning for SLR. Uncertainties in food systems change revolve around what combinations of strategies, models and pathways are most likely to push the dominant food regime in the direction of transformation. As discussed in Paper B, a transformational shift in the global food system is beyond the scope of individual food initiatives (Holt Giménez & Shattuck, 2011); collective and political action will be required to bring about transformations (Holt Giménez & Shattuck, 2011; Scoones et al., 2015). However, as discussed in Paper B, even small-scale change is valuable (Hendrickson & Heffernan, 2002; von Oelreich & Milestad, 2016). Seen from an MLP, social innovation (Marsden, 2013) and persistence are crucial in long-term niche creation (van der Ploeg et al., 2014). Together, individual Organic 3.0

initiatives can build niches, which may in turn influence the overall organic niche and the wider food system as a whole (von Oelreich & Milestad, 2016). As uncertainties remain around how best to bring about food systems change, a variety of methods, models and initiatives should be encouraged.

As explained by Seyfang & Haxeltine (2012), the relationship between niche and regime is characterized by contestation, and an MLP explains key ways in which niches can influence the regime; notably through growth, replication, learning and questioning the regime. While sustainable food systems have to grow, including through replication, to succeed in building an alternative, they also share certain aspects of pathways towards regime change with planning for SLR: both in terms of learning and questioning of the current regime/paradigm.

In terms of learning, dynamic robustness (Ranger et al., 2013) and sustainability (Raworth, 2012) should be key concerns both in planning for SLR and in transforming the food system. Currently, to a large extent planning approaches are not robust, as shown in Paper A. Many municipalities do not plan for SLR at all, and others demand specific SLR levels to plan for. However, dynamic robustness demands novel approaches such as scenario planning under uncertainty and also taking worst case scenarios into consideration. Likewise, the global food system is not sustainable, but in need of transformations in the direction of strengthened sustainability. Moving towards a "safe and just space for humanity to thrive in" (Raworth, 2012:4) thus requires both (re)learning and understanding the importance of dynamic robustness and sustainability, as well as questioning dominant perspectives, structures and paradigms.

Handling and adapting to SLR depends on a change not only of planning perspective, but of guiding paradigm. In addition to considering worst-case scenarios, beyond the IPCC's 'conservative' estimates, long-term thinking (i.e. considering SLR also beyond the twenty-first century) is essential. This requires moving beyond conventional thinking. Societal transformations aimed at strengthening the sustainability of the food system relies on a double move beyond the conventional regime; replacing the current corporate regime with a food regime based on sustainable farming and continually strengthening the sustainability of the new regime, through a reflexive approach based on (re)learning. Furthermore, long-term thinking beyond the current century is a key component in transformational change towards sustainability in both fields discussed in this thesis. The global food system faces urgent problems, but also issues surrounding resource depletion that will take decades or more to unfold. Discussing more distant time horizons requires a shift in understanding and a fundamental "epistemic reorientation" discussed by McMichael (2011, p. 804).

Moving from currently dominant regimes to regimes (or paradigms) characterized by sustainability and dynamic robustness requires a shift in understanding connected to values and politics. Facilitating change demands building alliances centred on shared values of sustainability, and requires political engagement and planning supporting transformations towards sustainability. Such alliances and politics should not shy away from emphasizing that sustainability transformations involve radical and systemic changes in values, governance (Olsson et al., 2014; Raskin et al., 2002; Westley et al., 2011), social practices (Hinrichs, 2014), policies (Unruh, 2000; 2002) and economic structures (Holt Giménez & Shattuck, 2011; Raskin et al., 2002). As Schon succinctly puts it: "Something old must come apart in order for something new to come together" (1971, p. 51).

6 Policy recommendations

Based on the concluding discussion above, a number of policy recommendations can be formulated. In terms of planning for sea-level rise (SLR), key policy recommendations coming to light from this thesis are:

- Planning for SLR should be guided by robust planning approaches. Dynamic robustness, striving towards flexible strategies that are possible to change when knowledge on future SLR improves, is one key option.
- Worst-case (high-end) scenarios for future SLR should be taken into account in planning.
- In planning for SLR, the long-term perspective, beyond 2100, should be considered.
- In Sweden, the government should develop a national strategy for SLR planning. Linkages between the national and local levels should be improved.

In terms of a sustainable food system, key policy recommendations drawn from this thesis are:

- A variety of sustainable organic food initiatives, methods and models should be encouraged.
- Organic food initiatives should persistently strive to build niches and alliances departing from Organic 3.0 values.
- As sustainability transformations involve radical and systemic changes in values, governance, social practices, policies and economic structures, food systems change should be aimed accordingly.

7 Future research

In light of the two papers presented in this thesis, possible topics for future research can be outlined. Departing from Paper A, it would be valuable to expand the study on planning for SLR with an exploration of Sweden's main cities, Stockholm and Göteborg (Gothenburg), as well as expanding the study to the national planning level. Such a study could focus not only on the current state of planning for SLR, but also on how planners – and not least politicians – relate to planning for SLR under uncertainty, as well as to long-term time frames, dynamic robustness approaches, and worst case scenarios. It would also be very valuable to study barriers to adaptation and perceptions of climate change through a more detailed study of the main reasons behind the lack of consideration of SLR in a third of the municipalities studied in Paper A. Researching a national strategy for SLR would be another interesting option for future research. Furthermore, the scope of the research initiated in Paper A could be expanded to include climate change adaptation in planning, also beyond SLR.

Expanding the study of sustainability transformations to other organic food initiatives, or beyond organic initiatives within the food system to alternative approaches breaking with the dominant regimes in e.g. the banking and forestry sectors would be an interesting research continuation from Paper B. This would provide alternative examples of the potential for niche-regime transformation, as ethical/ecological banking and sustainable forestry can be seen as niche innovations challenging dominant regimes in their respective fields. As in food systems change, the purpose would be to study how alternatives can push

the regime in the direction of a transformational shift, and to improve understanding of how change comes about. Policy-level studies of Sweden's national strategy for food production would also be interesting. Additionally, the research in Paper B could be expanded to encompass also the citizen perspective on food systems transformations.

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