



Unravelling Urban Agriculture

A Pathway To Resilient Food Systems

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Preface

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Abstract

Starting from the notion that there are several flaws in our food system causing severe (socio-) ecological harm - it was noted that the emerging concept of urban agriculture could potentially serve as a useful tool to mitigate these flaws. Being practiced in various forms throughout society (from gardens to capital-intensive vertical farms) - it was therefore argued that different discourses on urban agriculture might be present. Argumentative discourse analysis served as a methodological approach by which preliminary signs of three discourses have been successfully identified, if urban agriculture is to increasingly enter politicised arenas. These discourses are - (1) *socio-educational*, (2) *incremental optimisation* and (3) *regime changing*. All having the common goal of sustainable food systems in mind - the three discourses respectively advocate for a systems-wide change through ecologically centred thinking; a business-driven incremental optimisation of the conventional food regime; and an innovation-driven regime change towards democratisation of the food system. Although envisioned sustainable food system states differed between the discourses - four common issues were identified that might hamper urban agriculture to develop on a larger scale. These issues relate to (1) *land and property price*, (2) *market structure and its effect on producer-consumer interaction*, (3) *fossil fuel-lock in*; and (4) *bureaucracy and organisational structures*. Being a two-fold analysis, resilience has been operationalized for the abovementioned results to structurally unravel the complex socio-ecological system dynamics upon which urban agriculture touches - e.g. climate change mitigation, preserving biodiversity, how market forces link with poverty, knowledge transfer and changing governance structures. After an extensive discussion, comparisons with literature and synthesis of the results from discourse analysis and resilience - the following conclusions have been drawn. In the eye of resilience-thinking, opposing propositions between discourses can be regarded as potent tools to conjunctionally pave the pathway towards resilient food systems - since they seem to focus upon different resilience-building components of socio-ecological systems. Therefore, focal points matching the respective expertise of the discourses are sketched, by which they can structurally increase food system resilience. Taking into account the methodological limitations, advice is formulated for decision-makers and future research alike to validate and expand on these findings.

∪ *Keywords: urban agriculture, discourse analysis, resilience, food transition*

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1. Introduction

The world is currently in a state of rapid, severe change (IPCC, 2014). Climatic disasters, resource depletion and ongoing population growth call upon humanity to take action (Brundtland, 1987). Furthermore, projections estimate the world population to grow towards approximately 9 billion by the middle of this century (UNFPA, 2013; UNDESA, 2013). With so many extra mouths to feed, an integrated and systematic approach to food security is of great importance. Global food security is currently at risk through e.g. its coupled rising food and oil prices (Pfeiffer, 2013; Ruel, 2010), water scarcity affecting the productivity of land (Gleick, 2000) and phosphorus depletion affecting (synthetic) fertiliser supply (Cordell, 2009; Ashley, 2011). Furthermore, conventional, large-scale agriculture – the main form of current global food supply – is often characterised by unsustainable practices (Despommier, 2009). These flaws are e.g. agricultural intensification, monoculture and its accompanying use of herb- and pesticides (Solér, 2012), extensive energy and materials required for production, processing and distribution (Giampietro, 1994; Paxton, 1994), and the decoupling of consumers and industry creating non-transparent supply chains (Feenstra, 2002; Gladek, 2011).

Apart from population growth, environmental degradation and resource depletion, another trend is observed - urbanisation. In 2008 the world's urban population exceeded its rural population, with 60 per cent expected to live in urban areas by 2030. This will shift poverty to urban areas, since despite the comparative advantage of cities (e.g. entrance to labour market and education), wealth in urban areas is relatively less equally dispersed (UNDESA, 2014; Ravallion, 2001). There are reported close links between urban poverty and food insecurity (Ruel, 2010; Levin, 2000). This in turn negatively influences human health, due to processed, lower quality foods being generally cheaper than sustainably sourced, healthy products. This causes an increased risk for obesity, heart diseases and cancer (among the poor) (Cummins, 2006; Ruel, 2010). These low-pricing problematics persist due to mass production and its accompanying externalities (costs of environmental and human harm) not being internalised (Dean, 2013; Tilman, 2002).

Abovementioned issues all call upon an increased demand for sustainably sourced and healthy, yet affordable products - if we are to feed the growing urban population without exacerbating current problems. That is a domain where urban agriculture is heralded to play a role. Currently, many forms of urban agriculture are increasingly

emerging – from peri- to intra-urban agriculture, community gardens, rooftops and vertical farming, practiced both small-scale and bottom-up to more commercial and institutionalised (Despommier, 2009; Mok, 2014; Pearson, 2010; Veenhuizen, 2006). In scientific literature and policy documents it seems that urban agriculture is often presented as a panacea alleviating previously mentioned environmental stressors (e.g. by shortening supply chains, necessity for food processing and herb- and pesticide use) - as well as serving a myriad of other socio-economic goals (e.g. by stimulating social cohesion, creating job opportunities, equity and education) (e.g. Gemeente Amsterdam, 2015; Gemeente Rotterdam, 2012; Mok, 2014; Muynck, 2011; Pearson, 2010). Furthermore, since urban agriculture “greens” cities, it can stimulate biodiversity (by creating habitats), mitigate the urban heat island effect and improve air quality and rainwater retention (Gill, 2007).

Contrastingly to literature mentioned above, some criticise urban agriculture might not be able to become a radical alternative food system in an environment strained by capitalist and neoliberalist markets (McClintock, 2014; Galt, 2014). Indeed, urban agriculture is often characterised by small-scale production and intensive physical labour, which does not meet the production efficiency from conventional industrial agriculture. A lacking integrated approach to sustainable food system transitions might therefore cause urban agriculture to remain in its niche. Since urban agriculture and is practiced in various forms and discussed in multiple facets of society (Pearson, 2010), one might therefore expect various discourses on the usability of urban agriculture to be present. Analysing discourses can serve to systematically bring forward several core themes of (environmental) social science issues, such as the content, process, effects and context (Runhaar, 2006). Since discourses dictate thinking about particular subjects, the dominant one can often become a clear indicator for (policy) outcomes (Hajer, 2005). Differing perspectives on the usability of (various forms of) urban agriculture by e.g. regulatory and practicing stakeholders might therefore affect how urban agriculture and food system transitions in broader sense shall manifest. This research therefore aims to grasp the discourse(s) present within the urban agriculture playfield – and thereby gain insights on issues that might hamper urban agriculture from delivering the environmental and socio-economic benefits for which it is so often credited.

An emerging concept, which could furthermore be useful in steering urban agriculture and sustainable food system transitions, is resilience. Resilience assessment, originating from system dynamics, can serve to operationalize both social and ecological

environmental stressors and (future) coping mechanisms. Biggs (2015), describes resilience as the capacity of "...a socio-ecological system to sustain a desired set of ecosystems services in the face of disturbance and on-going evolution and change". Urban agriculture can be regarded as a socio-ecological system where human behaviour and ecosystem services are highly interwoven (Goddard, 2010). Resilience, however, is a relatively novel and not clear-cut assessment method (Davoudi, 2010). Moreover, there is still a need for further analysis which operationalizes resilience and what this yields in practice for complex, interconnected socio-ecological systems (Harris, 2011).

Implicit linkages seem to be present between urban agriculture (holding and contributing to socio-ecological system dynamics (Goddard, 2010)) and resilience thinking (an assessment method for steering socio-ecological systems (Biggs, 2015)). Combining these might provide relevant insights - since (dominant) discourses are often a precursor for (policy) outcomes (Hajer, 2005) and resilience frameworks might be able to steer decision making into socio-ecologically beneficial scenarios (Harris, 2011). Greater insights in discourses can thereby stimulate understanding and cooperation among stakeholders, which is heralded as an essential aspect of resilient systems (Biggs, 2015; Davoudi, 2010). This research therefore hypothesises that there are several urban agriculture discourses holding explicit or implicit linkages to resilience - which in turn provides insights to operationalize resilience for urban agriculture.

Being a two-fold analysis, this explorative research aims to trace the discourses present on urban agriculture and its relation to sustainable food system transitions. The claims exerted by stakeholders within these discourses allow for issues hampering urban agriculture to be identified. These findings then enable assessment of potential linkages between urban agriculture and resilience. This research thereby aims to operationalize a set of relevant resilience principles for urban agriculture. Vice-versa, this research can provide insights in the operationalization of socio-ecological resilience. Following the abovementioned notions, the research question and sub questions of this research state:

What insights do urban agriculture discourses and resilience thinking provide for understanding food system transitions?

- *What discourses on urban agriculture and its relation to sustainable food system transitions can be identified among various relevant stakeholders?*
- *What are the issues hampering urban agriculture to develop on a larger scale?*
- *What does operationalizing resilience for urban agriculture entail?*

2. Theoretical background

In this chapter the theoretical background that served as a foundation to this research is elaborated upon. This consists out of *argumentative discourse analysis* by Hajer (2005) and *resilience* - specifically the methodology by Biggs (2015). It is described how these two theoretical approaches relate to and effectively address the aims of this research.

2.1. *Argumentative discourse analysis*

Discourse analysis is a multifaceted field in qualitative analytics, which investigates complex entangled debates around e.g. socio-economic, policy-related, philosophical and environmental phenomena. In a broad sense, applying a discourse analytical perspective could be described as assessing language beyond the sentence and implications beyond the practice – and thereby how social and decision-making processes are shaped (Shiffrin, 2008). Having its origins by Foucault assessing how power structures manifest and uphold in society, discourse analysis can be applied through various lenses. These lenses can be mainly distinguished from specific linguistic-oriented methodologies to broader oriented ones, where arguments, context and lines of thought surrounding issues and their related (institutionalised) practices are assessed (Runhaar, 2006; Kern, 2010).

The latter category is where *argumentative discourse analysis* (Hajer, 2005) falls under. This research draws upon that approach, where discourse is specifically defined as “..the ensemble of ideas, concepts and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set of practices” (Hajer, 2005). *Argumentative discourse analysis* focuses on the notion that different interpretations on issues arise due to variability in context and consequent framing – which are embedded in the storylines that conjunctionally form a discourse. Storylines are a generative sort of narrative by which actors exert argumentation and frame issues towards others. *Argumentative discourse analysis* tries to grasp which storylines are present around certain topics - and thereby the (dominant) focal points that dictate those debates and decision-making processes. By tracing the discourses, Hajer’s approach thus aims to investigate the how, what and why by “..which actors seek to persuade others to see reality in the light of the orator” (Hajer, 1995).

This approach has been chosen to guide this research for the following reasons. Divergent views on (technological) change are argued to lead to opposing policy prescriptions and be decisive for the level of engagement and commitment among relevant stakeholders (Grubb, 2005). Urban agriculture has hitherto shown to be of multifaceted nature and heralded high-changing potency, while still in an emerging phase. Before concept crystallisation and entering a more politicised arena, *argumentative discourse analysis* could thus provide useful insights in what discourses on urban agriculture and its relation to sustainable food systems entail – and consequently how their storylines might dictate how urban agriculture will manifest within society. Since *argumentative discourse analysis* also assesses context around the arguments, the way which actors give meaning to related societal orders, perceived sustainability performance of urban agriculture and propositions for food system transition can be illuminated.

For example, conflicting storylines on the usability of urban agriculture between e.g. regulatory and practicing stakeholders might cause vacant spaces fit for gardening not getting assigned to bottom-up initiatives by municipalities, or starters credit not being granted to launch a micro-business. A specific discourse can promote urban agriculture development if it is shared among and connects e.g. producers, retailers and policy makers. Discourses could also potentially exclude certain stakeholders. Examples could be when supermarkets or other businesses frame urban agriculture as irrelevant and thus continue buying from macro-scale agriculture (steady, high quantity food supply), but neglect emerging meso- and micro-scale urban agriculture and thereby hamper their development (variable, seasonal, lower quantity food supply from e.g. community gardens and rooftops) (Pearson, 2010).

Although not the main focus of this research, through delving into these storylines, signs of potential discourse coalitions can be spotted. When an issue at hand reaches politicised arenas, discourse coalitions might form when discursive groups share a set of common storylines, while likely still disagreeing on various topics (Hajer, 2005). Through adhering to those shared storylines, these stakeholders often collaborate within larger debates to gain achieve and maintain a dominant position - while simultaneously competing with their coalition partner(s) for dominance of their specific discourse when coalition dominance is achieved.

2.2. *Resilience*

Where the first approach in this research aims to trace discourses and consequent insights on issues hampering urban agriculture – the second approach aims to operationalize resilience using those findings. Resilience thinking aims to understand complex system dynamics and how interlinked complex (socio-ecological) systems act and react in the face of disturbance, shocks and uncertainty. Having its origins in ecology and system dynamics, resilience can be operationalized in various ways (e.g. engineering, evolutionary and ecological resilience) to assess complex socio-ecological systems (Davoudi, 2012; Folke, 2006).

Urban agriculture can be regarded as a complex socio-ecological system (Goddard, 2010). As mentioned in the introduction, Biggs (2015) describes socio-ecological resilience as the capacity of “...a socio-ecological system to sustain a desired set of ecosystems services in the face of disturbance and on-going evolution and change”. Resilience thinking thus focuses not only on how external drivers influence desirable system states – but also on the internal system interactions and their development. Operationalizing resilience then assesses the amount of change a system can undergo before it falls into a different system state, thus assessing its flexibility and capability of self-reorganisation (Walker, 2004). Socio-ecological resilience additionally emphasises the ability to stimulate capacity for learning and governance-related adaptation within the system (Carpenter, 2001).

Urban agriculture, being the phenomenon of inquiry, is heralded to be a potential force in reaching (resilient) food systems by bringing an array of socio-ecological benefits. To integrate alternative food systems, severe changes that divert from status quo strategies seem required. These can entail changes in city development, institutions, markets, governance, applying innovative agricultural approaches, and so forth (Pearson, 2010). Therefore, it is of utmost importance that these potential transitions are thoroughly assessed to what extent their resulting states are more preferable and sustainable than conventional systems. By doing so, one can better understand how urban agriculture encompasses and contributes to resilient systems. This in turn addresses the requested need of operationalizing resilience for socio-ecological systems (Harris, 2011).

By qualitatively exploring resilience for urban agriculture, this research can thus provide insights for policy- and decision-making processes to strengthen (food system) resilience. Resilience principles which could be operationalized for urban agriculture are e.g. *flatness* – addressing abundantly sprouting bottom-up food initiatives, or *buffering* – addressing the necessity to continue preserving larger scale agriculture to compensate for potential non-sufficient urban food supply (e.g. when famines occur). These are traditionally more technical resilience principles that have been operationalized for climate adaptation in urban deltas by Wardekker (2010).

Following a more inherent qualitative approach, the resilience principles from Biggs (2015) seem fit and directly linkable to the results this findings this research aims to operationalize – qualitative findings stemming from document and discourse analysis (how this is pursued will be further described in the methodological section). For example, *maintain diversity and redundancy* could be linked to statements on avoiding monocultures to preserve biodiversity, ecological health and reduced pest outbreak risk. *Broaden participation* and *encourage learning* could be linked to the social, participatory nature of food gardens and repairing decoupled links between consumers and (conventional) food industries.

In *Table 1*, these seven resilience principles by Biggs (2015) are described in more detail. The first three principles (addressing diversity and redundancy, connectivity and slow variables and feedbacks) relate to system properties that ought to be managed in order to maintain its (eco) system services – whereas the latter four (addressing systems thinking, learning, participation and polycentricism) relate more towards the enhancement of socio-ecological systems governance and stakeholder communication (Biggs, 2012).

This approach thereby allows exploring the resilience of urban agriculture as a food system service, its relation to ecological functioning as well as the social and economic dynamics that are at play for urban agriculture (stakeholders). Furthermore, this set of resilience principles is judged fit since it adheres to "...resilient social-ecological systems in particular rather than complex systems in general and have implications for both the measurement and assessment of resilience" (Quinlan, 2015). Although many approaches to resilience could be potentially be operationalized for urban agriculture, this specific approach has been chosen to conduct the second part of this research due to aforementioned similarities.

Table 1. The seven “resilience principles” and adhering key messages which provide the necessary understanding to operationalize resilience. Text adopted from Biggs (2015).

Resilience principle	Key message
Maintain diversity and redundancy	“Systems with many different components (e.g species, actors or sources of knowledge) are generally more resilient than systems with few components. Redundancy provides ‘insurance’ within a system by allowing some components to compensate for the loss or failure of others. Redundancy is even more valuable if the components providing the redundancy also react differently to change and disturbance (response diversity).”
Manage connectivity	“Connectivity can both enhance and reduce the resilience of social-ecological systems and the ecosystem services they produce. Well-connected systems can overcome and recover from disturbances more quickly, but overly connected systems may lead to the rapid spread of disturbances across the entire system so that all components of the system are impacted.”
Manage slow variables and feedbacks	“In a rapidly changing world, managing slow variables and feedbacks is often crucial to keep social-ecological systems “configured” and functioning in ways that produce essential ecosystem services. If these systems shift into a different configuration or regime, it can be extremely difficult to reverse.”
Foster complex adaptive systems (CAS) thinking	“Although CAS thinking does not directly enhance the resilience of a system, acknowledging that social-ecological systems are based on a complex and unpredictable web of connections and interdependencies is the first step towards management actions that can foster resilience.”
Encourage learning	“Learning and experimentation through adaptive and collaborative management is an important mechanism for building resilience in social-ecological systems. It ensures that different types and sources of knowledge are valued and considered when developing solutions, and leads to greater willingness to experiment and take risks.”
Broaden participation	“Broad and well-functioning participation can build trust, create a shared understanding and uncover perspectives that may not be acquired through more traditional scientific processes.”
Promote polycentric governance systems	“Collaboration across institutions and scales improves connectivity and learning across scales and cultures. Well-connected governance structures can swiftly deal with change and disturbance because the right people address them at the right time.”

3. Methodological approach

The analytical framework that has been used to methodologically conduct this study is summarised in *Table 2*. Initial desk research, document analysis, helicopter and semi-structured interviews provided the methods for data collection. Value mapping and argumentative analysis provided the methods by which this research answered the first two sub questions relating to discourses. The findings from these previous steps have been used to operationalize a set of resilience principles – answering the last sub question. These steps shall be described in further detail throughout this chapter.

Table 2. Analytical framework of the data collection and analysis steps conducted.

Steps	Gains
Initial desk research and helicopter interviews	First notion on urban agriculture and links with resilience were gained through literature and helicopter interviews with well-informed actors. In the process, relevant stakeholder groups were detected by snowballing.
Document analysis	Deeper knowledge on urban agriculture and resilience, allowing for formation of interview themes and exploring linkages with resilience.
Semi-structured interviews	Data collection by conducting a series of fourteen in-depth, semi-structured interviews on urban agriculture and sustainable food systems.
Value mapping and argumentative analysis	Decoding the various interviews claims into frames that typify storylines within discourses. This is pursued to gain an understanding of discourses and issues around urban agriculture.
Operationalize resilience principles	Re-analysing the key documents and (interview) results from discourse analysis through a lens of resilience.

3.1. Data collection

Following suggested steps provided by *argumentative discourse analysis* (Hajer, 2005), this research initially started out with desk research on scientific articles, policy documents and grey literature (e.g. news articles and online forums). These steps have been conducted to achieve a first notion on the main motives for, issues hampering and stakeholders active in urban agriculture - as well as exploring resilience. Accompanying this initial desk research, three helicopter interviews with well-informed actors were held – which iteratively allowed access to and knowledge about a broader range of urban agriculture stakeholders and documents. These interviews furthermore provided first insights on the linkages between urban agriculture and resilience and opened doors to a deeper level of document analysis. Here, (scientific) literature on urban agriculture

and resilience was explored to gain an understanding what resilience could entail for urban agriculture – and vice versa. A continuous reiteration of document analysis throughout the research process was performed to attain thorough knowledge on developments within urban agriculture. The stakeholder identification methods *knipselkrant method* and *snowball sampling* (Van der Sluijs, 2003) have been performed throughout these aforementioned steps, in order to acquire a list of relevant stakeholder groups until the amount of identified stakeholder types was relatively saturated (meaning no new types of importance are identified). These stakeholders plus a short description of their relevance to this research are listed in *Table 3*.

Table 3. Stakeholders and their relevance to urban agriculture and (conventional) food systems. List acquired by snowballing. All except the latter two types were interviewed.

Stakeholder type	Description
Pioneering decentralised market initiatives	Both actors were active in decentralised food provision businesses, where they cooperate with local-minded farmers and urban agriculture initiatives to bypass the conventional retail chain.
Municipal actors	The municipal actors were responsible for maintaining local urban agriculture development and networks.
Governmental actor active in top sectors policy	This actor was active in top sectors policy. This policy is formed through joint cooperation between government, industry and science institutes to stimulate knowledge-intensive economy and innovation. It plays a large role in (inter) national food production.
Governmental actors consulting on sustainability	One was a ministerial actor active in urban agriculture policy. The other two were active in sustainable innovation, whereby one was focused on broad sustainability and the other on horticulture innovation.
Urban agriculture researchers	Two environmental (university) researchers were independently interviewed. Both actors are highly active in urban agriculture research and development of innovative agricultural projects.
Small-scale urban agriculture practitioners	One was a life-long urban gardening focus-group member. The second was a local environmental organisation-affiliated gardening facilitator. The third was a permaculture lecturer.
Third parties	One actor was assessing viability of alternative food chains for an agricultural employer's organisation. The other worked for a landscape architectural bureau and has been assessing urban agriculture pitfalls.
Vertical farms using LED-lights	High-tech (urban) vertical farming using LED-light are an emerging form of urban food production.
Conventional retail chain	The conventional retail chain, e.g. supermarkets or mediating parties, play a large role in food security but also maintaining the status quo food regime.

A total of fourteen representative stakeholders whom have been successfully contacted were interviewed (all stakeholder types except the latter two listed in *Table 3*). The *semi-structured interview* method (Cohen, 2006) has been used, which allowed straying away from themes when appropriate - e.g. when interesting left turns in the conversation occurred. Themes addressed in the interviews have been provided via the previous steps - and ranged from (a) how stakeholders perceive urban agriculture and what might hamper its development; (b) what sustainable food systems should entail; (c) how and which stakeholders should act to enable sustainable food supply; (d) what role do e.g. market dynamics, technological innovations play; and so on. Resilience principles by Biggs (2015) have not been deeply discussed during the interviews - in order to assess whether resilience thinking is already embedded in various discourses without creating bias. How linkages with resilience are traced is described in the upcoming sub-chapter. Following oral consent, all in-depth interviews have been conducted anonymously in person, recorded and transcribed. All stakeholders were active in the Netherlands and therefore, naturally, the interviews have been held in Dutch. Interviews durations ranged from approximately an hour, up to two hours.

3.2. *Data analysis*

The steps and school of thinking presented by Hajer (2005) served as inspirational principles during the interviews and data analysis - by scrutinising e.g. positioning regarding urban agriculture, key points of argumentation and incidents which led to claims addressed. Most steps that Hajer proposes for discourse analysis, however, focus on analysing debates (material) where opposing conflict between stakeholder shine through (e.g. minutes of inquiry, interplay and sites of argumentation). Since urban agriculture is still emerging and yet to reach abundant concrete politicised arenas, this research analyses discourses via *value mapping and argumentative analysis* (Fischer, 1995; Van der Sluijs, 2003). This approach served to decode argumentation lines from the interviews. The claims from the interviews have been labelled, subsequently translated and categorised according to the four levels of possible (dis) agreement between stakeholders - which are described in *Table 4*. This analytical approach seems fitting to discourse analysis - since it helps tracing storylines exerted by stakeholders into frames that conjunctionally structure them. To sketch this, discourses can well be similar in their storylines on problem setting (e.g. when addressing much-agreed upon sustainability aspects) - while adhering to a completely different ideology or set of tools

to tackle that specific problem. Moreover, even with the same tools, envisioned (fair) outcomes can differ between discourses. In this sense, this approach goes further than other similar frameworks, which focus more on empiric and normative cause-effect relations (e.g. causal policy or narrative analysis) than influence of ideology-tainted aspects and controversies (Wardekker, 2009). Agreements, mismatches and unprecedented statements provided insights in discourses and issues hampering urban agriculture. Indirectly, this helped detecting linkages with resilience, since ideology, problem solving and outcomes relate to envisioned system states.

Holding a continuous explorative nature, potential linkages between resilience and urban agriculture have first been assessed during initial desk research and helicopter interviews. The seven resilience principles by Biggs (2015) as listed in *Table 1* served to re-analyse the interview insights through a lens of resilience. Urban agriculture literature found throughout document analysis was thereby similarly analysed. This operationalization thus explored what resilience could entail for urban agriculture and building resilient (food) systems via assessing existing literature, traced discourses and its subsequent insights. Per each principle, linkages have been qualitatively described for (a) interview results; (b) key documents; and (c) role of discourses.

Table 4. Four levels of possible (dis) agreement between actors, following value mapping and argumentative analysis (Fischer, 1995). Text adopted from Van der Sluijs (2003).

Level of argumentation	Description
Ideological view	“This is the deepest level of disagreement and can lead to very different views of whether there is a problem or what it is. One can hold the view that a radically different ideological starting point is required. Ideological argumentation focuses typically on ideology and alternative societal orders.”
Problem setting and goal searching	“Groups may agree on the existence of a problem, but not on identifying precisely what the problem is, how to formulate it, and what the end goal or solution point should be.”
Problem solving	“Groups may agree on the existence of a problem and further agree on policy goals but disagree on the strategies and instruments required to reach the goal. Problem solving argumentation typically focus on effectiveness, side effects, and efficiency of methods.”
Outcomes and fairness	“Groups often care about the fairness of solutions to problems, but can hold different views on what constitutes fair outcomes. Fairness argumentation focuses typically on public interest, unexpected societal side effects, and distributive justice.”

4. Discourses on urban agriculture

When analysing the interview responses on urban agriculture and its relation to sustainable food systems, three discourses can be distinguished (Table 5). The storylines, which conjunctionally structure these discourses, are elaborated upon in the remainder of this chapter.

Table 5. Discourses on urban agriculture and their characteristic storylines.

Discourse	Storylines
Socio-educational	Urban agriculture is framed as a phenomenon, which has a foremost educational role in creating awareness on ecological functioning and strengthening the weakened link between society and nature. Ecosystems ought to be cherished and food grown organically. Furthermore, participation and social cohesion among communities and cultures are key characteristics for a sustainable society. Neoliberal economic thinking is blamed to have taken over the common framing of urban agriculture since its broad emergence - by focusing too rigidly business potential and production output instead of ethics.
Incremental optimisation	Urban agriculture is framed as a small-scale symbolic activity and is mainly neglected in this discourse when discussing food security. Society should not overestimate impact of urban agriculture and other alternative forms of food production – the conventional food system has its flaws but also great successes. Innovations within high-tech agriculture that optimise resource efficiency will tackle global food security and sustainability issues. Implementing circular systems is thereby key. Incremental optimisation of the status quo through international business and government cooperation are the means to move society and industries towards global sustainability.
Regime changing	Urban agriculture is framed as a clear characteristic of a transitioning society – where horizontal power structures and decentralised market initiatives will replace top-down dominance. Working within the boundaries set by current dominant regime – vertical decision-making processes and subsidised markets – is unable to tackle the pressing global sustainability issues society faces. Peer-to-peer technologies and open innovation combined are potent elements for regime change. Production needs to be characterised by optimal transparency – this aids consumer awareness on whether food is sustainably produced. Such technologies can further enhance product optimisation and match supply and demand. Market forces are an important tool for regime change and low-tech agriculture is too often neglected should co-exist with high-tech where apt – pragmatism is key.

4.1. *Socio-educational discourse*

Small-scale urban agriculture stakeholders seem to exert a discourse that could be described as *socio-educational*. In this discourse emphasis is placed on the social and ecological ethics that encompass practicing urban agriculture. Cultural interaction and social cohesion plays a great role. Through urban gardening, communities from different ethnic and societal backgrounds can come together and participate. This helps mutual understanding and acceptance to reach stability in multicultural societies – which is necessary in an age where polarisation between communities is stirring ethnic turmoil (e.g. regarding refugee influx in Europe). Urban gardens and allotments are have always acted in this social manner. Throughout history these served as learning spaces - by helping immigrants with integration into society as well as providing care for e.g. mentally disabled or psychiatric patients. Urban agriculture hereby combines social value with its inherent ecologically centred educational aspects through food cultivation.

A complaint towards the current trend on urban agriculture, which has been put forward within this discourse, is the dependency on neoliberal, economic activity for project emergence and survival. It is thereby sketched as if the means to sustainable development are largely hijacked by market ideology. This has as consequence that urban agriculture is currently too rigidly focused on the production side – and not on the awareness side. The ethical values which urban agriculture drives upon are not graspable in economic sense¹ and this risks such activities being framed as irrelevant and losing support by policy makers and businesses. While stakeholders within this discourse did not always seem to agree upon the potential to actually contribute in self-sufficiency and food security – urban agriculture was widely regarded to be mainly about reinforcing the narrative surrounding food cultivation. Food systems should strive to be conducted in an agro-ecological manner since this is regarded the most natural and sustainable option. The quality of food grown through intensive and technical means cannot compare with organically grown food harvested from healthy, natural ecosystems.

It should be noted that the educational arguments are not limited towards urban agriculture itself but applies to society as a whole. In this discourse it is thereby

¹ Arguably, preferring socio-ethical above economical values creates an atmosphere in which society can better pursue long-term economic productivity in a sustainable manner.

emphasised that a deep misunderstanding is present within mankind that disconnects its morals and activities from impacts on the natural world. Regarding conventional food production this accounts for the general ignorance by consumers, on its negative ecological implications. Collective switches in mind-set, which embrace ecological and societal values independent of economic outcome, are desperately needed. Urban agriculture therefore is a tool, which shapes awareness and invigorates the bonds between the human society and the ecological systems it is so dependent on. Participation and care among social groups needs to be enhanced. Through aforementioned lines of thought the food system can be re-designed in a circular, ecologically sound manner.

4.2. *Incremental optimisation discourse*

Governmental actors involved in top sectors policy, horticulture innovation as well as third parties active in the conventional agricultural sector seem to exert an *incremental optimisation* discourse. Within this discourse, slight variations are present on core values emphasised. The governmental parties are typified by their focus on business-driven technological interventions and knowledge intensive circular systems to safeguard food security – foremost within conventional agricultural systems, though urban innovations are increasingly recognised. International cooperation and export, which increasingly shifts from physical products towards knowledge, can strengthen both global prosperity and Dutch economy.

The third parties used less technological language than the governmental parties but do similarly show a more critical eye towards urban agriculture being heralded as a serious means to achieve sustainable food systems - a claim found within the other discourses. While agreeing upon the necessity to tackle several environmentally harmful flaws of the globalised food system, this discourse addresses the successes of the conventional food system. In regard to food security, current import and export often results in efficient, guaranteed production and supply - especially in Europe where sustainability production standards are high and majority of trade is conducted within continental boundaries. This discourse therefore does not seem too enthusiastic towards urbanised food systems as a radical replacement to the status quo - unless this is proven to actually be the more sustainable option.

Although within this *incremental optimisation* discourse there is similar recognition and support for decentralised innovations, emerging new markets and the necessity for effective sustainable development, it seems a distinct discourse since it leans more towards vertical instead of horizontal intervention mechanisms. The means to reach sustainability are mostly through business, and the power of conventional effectiveness should not be underestimated. Optimisation within current regimes of instead of complete systemic transformation seems the common route envisioned.

Because of such focal points, urban agriculture is framed as a bottom-up symbolic practice aiding in food awareness - and therefore not the most impactful tool for sustainable food system transitions. The topic urban agriculture was therefore not deeply addressed when discussing the food transition - technological and business oriented means to reach sustainability came up in a more sparkling sense. It should however be noted that urbanised food systems were specifically addressed by developing circular, high performance urban greenhouse innovations - which points towards the broad interpretability of the urban agriculture concept. When discussing urban agriculture in relation to sustainable food systems with the governmental actor active in top sector policy, the response was more aimed at developing systems outside of cities and city-fringes. Implementing such systems through international collaboration was envisioned since the Netherlands possesses a global leading role in agricultural knowledge.

4.3. *Regime changing discourse*

A *regime changing* discourse seems to be exerted among urban agriculture researchers, sustainability-focused advisory governmental actors, municipalities and pioneering decentralised market initiatives. To some extent, this discourse embeds aspects of the former two discourses. This discourse similarly embraces the bottom-up transformative approach as seen in the *socio-educational* discourse. Parallel it embraces market-driven mechanisms upon actual transition processes as seen in the *incremental optimisation* discourse - albeit to be pragmatic. Notwithstanding those similarities, this discourse clearly distinguishes itself by the following. Firmly sketching urban agriculture as an emerging niche alternating from the status-quo food system, it advocates for a regime change instead of working within current boundaries set by dominant regime actors - markets and governments. Those boundaries, which are aimed to maintain the

globalised food system (agricultural subsidies, price competition and non-internalised externalities) are argued to fuel environmental degradation and thus do not function well enough for society to face and tackle pressing sustainability issues. To stimulate such change, the new regime needs to be characterised by horizontal governance and decentralised markets. To reach this the abovementioned regime change, technology and open innovation will play a crucial role. How exactly, will be described in further detail throughout this sub-chapter.

The aim for a regime change was furthermore clear through the critical notions addressed towards the conventional food system. Compared to the other discourses, interviewees here mentioned most bottlenecks for sustainable food system transitions, ranging from subsidy driven price competition, consumer mentality and agricultural practices to vertical power structures. Pioneering decentralised market initiatives respond to these bottlenecks by forming business models that divert from e.g. subsidy-dependence and monocultures. To do so, they collaborate with local-minded farmers and urban agriculture initiatives. Municipalities want to lay the foundations for urban agriculture to sprout by assembling a tactical and strategic network-role. Urban agriculture thereby characterises a living lab² environment where cities are incubators serving as a hatchery for sustainability innovations.

Although this discourse embraces the technology-focused aspects heralded by the high-end governmental stakeholders, the stakeholders firmly state that low-tech but knowledge intensive solutions should not be underestimated. An avid example is agro-ecology and ecosystem restoration, which can revive deteriorated agricultural landscapes. The latter is by no means an attractive short-term profitable objective, which can be regarded as long-term productivity building and local empowerment instead of a business-to-business approach. Yet, its successes have shown it to be crucial next to high-tech and intensive agricultural systems. Location-specific pragmatism is thus key to achieve sustainability. There is no best or worst option – vertical farming³ approaches are more relevant in cities located in desert biomes than in the northern hemisphere, while literal city farming seems more effective in megacities than in green large agglomerations as present in the Netherlands. Urban agriculture can create

² Living labs are “..an open and citizen-centric approach for innovation” (Bergvall-Kareborn, 2009).

³ Vertical farming is a high-tech approach to food production with high implementation costs. It is famed for its efficiency in water use (Despommier, 2009).

sustainable value for vacant spaces and public areas. In any case, circularity and systems thinking is key. Interviewees mentioned that high governmental and business decisions should be more ambitious towards urban agriculture development as well - and that this is hampered due to aforementioned boundaries causing a conventional regime lock-in.

In the *regime changing* discourse, urban agriculture is thus first and foremost envisioned as a catalyst towards a sustainable society. Current emerging sustainability niches can transform the conventional food regime to a new resilient state. Through peer-to-peer technology, demand and supply can be optimally matched, addressing consumer satisfaction and efficient production as well as providing low entry barriers for decentralised initiatives. This offers market access that bypasses conventional retailers who often demand continuous and convergent product supply. Feedback driven by peer-to-peer technology can also stimulate transparency and awareness on (food) production among consumers. In terms of innovation potential, acquiring open innovation combined with peer-to-peer sharing can surpass classical intellectual property-based business models. Drone technology can help sowing diverse seed patterns to avoid monocultures. These factors combined hold the ability to transit towards a flexible food system characterised by democracy and transparency.

5. Common issues on urban agriculture

As the previous chapter has shown, how urban agriculture and envisioned sustainable food system states are perceived differently between the discourses. However, several common issues which hamper urban agriculture and sustainable food system transitions were identified. These common ground between the discourses can be regarded as focal points by which to stimulate urban agriculture – and are elaborated upon in the remainder of this sub-chapter.

5.1. Land and property price

The land and property price in urban areas is currently too high for urban agriculture to successively take off on a large scale - albeit if it aims to act as a sole food production system. The price of land and its potential value to sustainable development by engaging in urban agriculture are decoupled, which makes e.g. housing companies or businesses

the higher bidder in property auctioning. Moreover, urban agriculture in vacant buildings often requires high retrofitting costs by which it often does not yet form closing successful business models.

This is furthermore echoed in the sense that even conventional agricultural practices conducted on relatively cheaper ground are highly dependent on subsidies to compete on the globalised market. Producers earn very low or no margin on their products since lots of capital is absorbed in the retail. Urban and urban focused agriculture, to be economically viable, therefore has to effectively forge innovative business models by introducing shared ownership of property, producing niche products, avoiding large retail chains or including other income activities on their property such as organising events and providing child- or healthcare.

5.2. Market structure and its effect on consumer-producer interaction

Retailers should embrace diversity and discontinuity of product supply to facilitate economically sound urban agriculture. Conventional agriculture answers market demand by operating on economies of scale, producing a quite narrow product repertoire combined with a steady supply. Urban agriculture averts from both those aspects. Decentralised market initiatives pioneer this upcoming and different market. To pressure large dominant retailers to undertake similar activities as these initiatives do, this thoroughly requires consumers to switch their purchasing behaviour by taking into account sustainability driven morals. The downside of this requirement is paying higher prices for urban agriculture products as long as the conventional market outcompetes these new niches. These mechanisms and aforementioned subsidy-driven conventional agriculture conjunctionally uphold the existing regime.

Multiple interviewees mentioned this complex race-to-the-bottom mentality that prolongs low pricing problems. Another necessity therefore lies with dominant retailers, where they should make pioneering choices to integrate urban agriculture instead of anticipating market demand. Switching the hierarchical structure in the food system towards increased horizontality and decentralisation is therefore beneficial for urban agriculture. Hitherto innovative business models have to be formed to reach economic balance but aforementioned switches can help urban agriculture to take off as sole food businesses. These measures make urban agriculture more profitable, which is

prohibited in the current regime - where large-scale retailers often receive a relative high share of sales. This disadvantages urban agriculture businesses with low scale production. Horizontality and decentralisation does not mean retailers should be completely avoided. Producers can still benefit from cooperating with mediating parties, which maintain customer relations who pay a fairer share than conventional retailers.

5.3. Fossil fuel lock-in

Another issue put forward by several interviewees is that the current agricultural system thrives off fossil fuel. Fossil fuel lock-in is a deeper issue that applies to sustainable development in general. Regarding agriculture this applies to long transport chains, mechanised processing, synthetic fertiliser and pesticide production, and so on. Developing urban agriculture and other models including short production chains - both characterised by a generally low carbon footprint - therefore do not yet have a clear economic advantage compared to conventional agriculture long as the current fossil fuel price does not increase.

This again points to the aforementioned necessity of urban agriculture to forge innovative business models to be economically sustainable. Fossil fuel lock-in could be broken when external costs of carbon emissions are being internalised or when e.g. geopolitical conflict causes oil production countries to drive up export costs. Furthermore, consumers can divert markets from fossil fuels by morally boycotting products with a high carbon footprint. Transparency on production processes can guide consumers to do so.

5.4. Bureaucracy and organisational structures

Urban agriculture is thus a phenomenon, which transcends and relates to numerous policy sectors and market domains. This offers high potential, yet organisational system lock-in renders an atmosphere unable to respond to urban agricultural complexities. Therefore, entry barriers for new initiative are upheld and smooth implementation is hampered. For example, ground allocation is done by another municipality department than hospitality approval for initiatives that want to include a restaurant in its business model. Rehabilitation garden projects innovatively financed through health care budget have to make special arrangements with health care institutions. Cross-sectorial

communication and cooperation is thus necessary, since inert bureaucracy and communication lag hampers development. Once multiple stakeholders recognise the broader implications of urban agriculture, inter- and intra-organisational structures can be adapted and streamlined for emerging initiatives to thrive.

Small-scale urban agriculture initiatives have noted this inertia discouraging enthusiasts to engage in, or develop, local initiatives. Since urban agriculture development is still a topic of interest, focus groups are developed that are often highly dependent on volunteers. Interviewees mention these groups can quickly lose momentum and become chaotic when funding has been cut or meetings are irregularly planned. Municipality actors acknowledge this and aim to develop platforms and networks for urban agriculture. Governmental sustainability advisors try to stimulate this by increasingly putting urban agriculture on the agenda, while avoiding policies that pinpoint in what forms urban agriculture should crystallise.

6. Options for resilience

In this chapter the insights from discourse analysis (interview results and key documents from desk research) are re-analysed through a lens of resilience. Each resilience principle as described by Biggs (2015) has been operationalized (*Table 1*). To do so, several options for what resilience could potentially entail for urban agriculture and its relation to sustainable food system transitions are described.

6.1. Maintain diversity and redundancy

This resilience principle contemplates that a system is often more resilient when it exists out of many diverse components. Interviewees exerted several claims addressing diversity – relating from market (structure) to agricultural practices. Urban agriculture researchers, sustainability-oriented governmental actors and pioneering decentralised market initiatives stressed that producers and markets alike should divert from centralised and monotonous⁴ supply. This poses environmental risks due to accompanying monocultures being a characteristic element of conventional agriculture

⁴ Economic efficiency strongly conditions markets and consumers towards monotonous products – especially regarding variations in species and shape of vegetables and fruits (e.g. Gladek, 2011).

and economies of scale – strategies having a market advantage in the current subsidy-strained atmosphere (see *chapter 5.2*). Urban agriculture tries to negate such practices by stimulating a diverse network of smaller decentralised producers, which produce in lower quantities while growing a wider variety of crops (and different sub-species, genotypic variation within a certain crop type). Urban agriculture researchers and small-scale urban agriculture practitioners called upon adopting agro-ecology as an alternative yet highly sound production mode. Van der Schans (2014) portrays how diverse agricultural systems can manifest in urban settings - e.g. using existing moisty and shady microclimates to grow mushrooms, transform existing large parks to public agro-ecological forest gardens and developing high-tech vertical farms.

Diverting from centralised supply, local-minded market initiatives and self-sufficient gardening projects furthermore add up to system resilience through their redundant functioning. Redundancy provides insurance by which system components can absorb shocks when other components break down, metaphorically contemplated by Biggs (2015) as “don’t put all your eggs in one basket”. Urban agriculture (in all its forms) can be regarded as a redundant component to safeguard food supply. Redundancy is even stronger when similar system components react different to shocks (response diversity). In that sense, urban agriculture can function as a buffer to feed cities when e.g. imported products are unavailable due to droughts in its production country. Self-sufficient gardening can absorb shocks when economic recession renders the purchasing power of consumers harmed (Lin, 2013; Altieri, 1999). Interviewees from the *regime changing* and *incremental optimisation* further addressed diversity by maintaining import and export-oriented agriculture. Growth of staple foods such as potatoes or wheat takes up vast areas of agricultural land and therefore cannot always be facilitated locally for most countries. Trade in turn functions as a buffer mechanism to food security, for might urban production experience shocks. Moreover, trade still plays an important role in economic development and should not be entirely neglected.

6.2. *Manage connectivity*

This resilience principle contemplates that a socio-ecological system becomes resilient when there is a fine balance to what extent system components are connected. If a system is well connected, it can recover more quickly from disturbances and shocks than when system components do not interact. However, if a system is over-connected,

disturbances can spread more easily and impact the system to a larger extent – and thus lower its resilience. Interview claims where connectivity shined through were on ecologically sound cities preserving biodiversity, implementing circular production systems to optimise resource use and maintaining high levels of market-consumer connection to stimulate knowledge transfer.

Foremost actors within the *socio-educational* discourse called upon the strength of urban agriculture to preserve natural ecosystem functioning. Ecologically sound cities help creating resilient cities capable to self-recover from disturbances. It was mentioned that healthy (urban) habitats preserve biodiversity through ecological connectivity. Urban gardens connect fragmented habitats within cities, serving as ecological corridors for species to safely migrate. This was heralded to be especially important in safeguarding pollinator routes. A rich abundance of diverse flowering plants provide nectar supply for e.g. bees that are increasingly endangered (Colding, 2006). Literature mentions more links between (ecological) connectivity and biodiversity protection - e.g. the potential of urban agriculture to enhance seed dispersal, create vertebrate nesting spaces and pest-control (Barthel, 2010; Goddard, 2013). Though contributing to biodiversity, overly ecologically connecting a city poses the risk that pollution and pathogens spread more quickly (Lin, 2015). To increase system resilience, urban agriculture researchers therefore mentioned implementing safe-buffer zones between agricultural production systems. Especially in monoculture-tinted agricultural land (e.g. staple foods), bio diverse green belts reduce negative connectivity around its system boundaries that might otherwise cause aforementioned disturbances to spread.

All discourses exerted claims that sustainable food systems ought to be designed in a circular manner by which resources are optimally recycled. Urban circular models connect separate sectors – e.g. by incorporating waste streams into production. Sustainable sanitation recycles nitrogen and phosphorus from human excreta streams into fertilisers for (urban) agricultural production (Cordell, 2011). *Incremental optimisation* discourse actors addressed this necessity by aiming to enable high-tech circular systems (both within and outside urban settings). Governments and big business alike can facilitate these capital-intensive systems – since costs of connecting separated sectors are high in often-disconnected linear environments. Urban poly-domes were mentioned as innovations to serve those ends (e.g. Gladek, 2011). Further examples are bio-digesting food and crop waste, collecting heat from sewer systems and

factories. Circularly obtained resources usable for e.g. gardens, greenhouses and vertical farms all help to enhance urban metabolism (McClintock, 2010; Paginu, 2010).

Where abovementioned linkages addressed ecological and resource-related options for connectivity, socio-economic connectivity of markets and actors also enhance food system resilience through stimulated knowledge transfer. Actors within the *incremental optimisation* and *regime changing* discourses addressed international cooperation stimulate sustainable production and food security by exporting knowledge to the developing world. *Regime changing* discourse mentions peer-to-peer technology can improve the connection between producers and consumers. This provides the feedback for transparency, trust and align supply and demand. Urban agriculture can further help connecting consumers to food sources at places where food deserts occur – areas where access to sufficient food is hampered by reduced financial and geographical proximity to markets (Hendrickson, 2006).

6.3. *Manage slow variables and feedbacks*

This resilience principle contemplates that systemic slow changing variables and its consequential feedbacks ought to be recognised to harness socio-ecological stability and ecosystem services. If a system shifts into a different regime state, this is highly difficult to reverse and can cause large disasters. Urban agriculture best adheres to this principle through its climate-change mitigating aspects. Pioneering decentralised market initiatives divert from fossil fuels by local production systems - avoiding transport emissions and the potential energy required for extensive periods of cooling and producing of package material. Fossil fuel lock-in yet hampers urban agriculture to develop (a common issue agreed upon by all discourses, see *chapter 5.3.*). Therefore, policies and behaviour that recognise long-term complex climate variability and feedbacks need to be formulated.

Municipalities see urban agriculture as a means to achieve carbon-neutral, sustainable and comfortable cities. The urban heat island effect is another example of a dampening feedback that can be mitigated through urban agriculture. Increased vegetation reinforces urban hydrological systems due to increased rainwater retention. Vegetation can uphold water in canopies and around root systems, mitigating urban peak water flows during storms. By providing apt water management and erosion control, urban

agriculture aids in preventing catastrophic flooding (Lin, 2015). Circular system, as portrayed in the previous sub-chapter, aim to avoid environmental feedbacks stemming from depleting non-renewable resources, adjacent pollution and its climatic disasters – such as phosphorus and fresh water aquifer exploitation (e.g. Cordell, 2011; Gleick, 2000). Actors within the *incremental optimisation* discourse specifically aimed to implement high-tech systems that embed circularity. High-tech equipment and computer models can monitor how resource use affects slow variables and feedbacks of ecosystems. Furthermore, since urban agriculture and green areas in general improve air quality and physical activity among citizens, long-term negative health impacts can be avoided (Gill, 2007). The *regime changing* and *socio-education* discourses further mentioned agro-ecological techniques can slowly revive deteriorated soils (enhancing agricultural productivity by reversing a negative regime state change).

Urban agriculture can furthermore provide a means to manage several socio-economic slow variables and feedbacks. Self-sufficiency and local (community) production helps alleviating poverty-traps and food insecurity. A famous case is Cuba, where after collapse of the Soviet Union food security and economic stability was severely under threat. Urban agriculture managed to rejuvenate Cuba back to a stable state – providing a resilient alternative for Soviet-dependant welfare (Altieri, 1999). It is important to recognise the stabilising potential of urban agriculture, since a negative feedback of food insecurity is conflict (Brinkman, 2012). Actors within the *incremental optimisation* discourse address these complex feedbacks by advocating for international cooperation with developing countries to safeguard food security. Actors within the *regime changing* discourse stressed that countries with high levels of undernourishment should first be providing sufficient food for their own nation before participating on the global free market. Transformation of subsidy-driven markets serves those ends (see *chapter 5.2.*). Actors within the *socio-educational* discourse emphasise that participatory urban agriculture strengthens social cohesion and consequent mutual understanding between cultures is essential for peaceful and sustainable societies.

6.4. Foster complex adaptive systems thinking

This resilience principle contemplates the necessity of shaping and maintaining an atmosphere that embeds systems thinking. Complex adaptive system thinking acknowledges unpredictability and interaction and change occurring on multiple system

levels at the same time. Adopting system frameworks that account for change and uncertainty in decision-making can foster complex adaptive systems thinking. The common issues on urban agriculture (*chapter 5*) illuminate complex adaptive systems thinking by acknowledging the link of food systems and market mechanisms, behaviour and (institutional) systems lock-in. How to respond towards system complexities seems to be perceived differently throughout the discourses. The *socio-educational* discourse, while most strongly emphasised by the interviewee lecturing in permaculture, views ecological systems so complex that ecological approaches ought to prevail over market- and technology driven approaches (“working with nature”). Constraints of neoliberal market approaches are mentioned similarly by the *regime changing* discourse – values that are not directly economically graspable ought to be taken equally serious when dealing with complex systems. Together with the *incremental optimisation* discourse, more trust is given to the potential of technological interventions. All interviewees mentioned system approaches and domain-transcending cooperation is necessary for sustainable (food) systems to manifest. Sustainability-oriented governmental actors further acknowledged system thinking also entails that inert actors holding conflicting perspectives should be convinced and motivated with care and patience. This is stimulated through stakeholder learning, participation and fitting governance – which are the principles further described in the remainder of this chapter.

6.5. *Encourage learning*

This resilience principle contemplates that continuous learning is necessary to understand and maintain resilience, since socio-ecological systems are constantly developing. Participatory research, collaboration and incorporation of various scientific, alternative and traditional knowledge types all encourage learning. Urban agriculture can help to ensure this - being a participatory activity embracing a diversity of production methods. The actors within the *socio-educational* discourse mention community-oriented urban agriculture has an essential educational role that invigorates ecological thinking. Encouraging children to engage in urban agriculture through e.g. school gardening projects can imprint this thinking from an early age onwards. Urban agriculture thus facilitates learning spaces that heal the weakened links between society and nature. This discourse draws upon agro-ecology and permaculture as alternative knowledge types. Barthel (2013) similarly links learning and urban resilience, stating the “..need to re-ignite urban minds about the close connection between urban people

and their life-support systems.” A learning mechanism mentioned there is that the performance of community gardens is able to serve as a proxy to monitor (local) environmental health.

Goddard (2013) states that ineffective knowledge transfer hampers sustainability and success of urban gardens. The *regime changing* discourse aims to stimulate knowledge transfer through peer-to-peer technology and open innovation (as an alternative to closed intellectual property-based innovation). Peer-to-peer technology encourages learning since it enables practitioners to share details on various (agricultural) knowledge types. Van der Schans (2014) sketches the necessity for openness in urban agriculture, since starting practitioners often do not possess keen background knowledge. Open innovation can furthermore stimulate self-sufficiency of e.g. marginalised communities (local or in developing countries) by granting free knowledge (“do-it-yourself manuals”). Interviewees further emphasised production and supply chains ought to be transparent – another relevant aspect for learning. Transparency combined with peer-to-peer technology can optimise production processes through enhanced consumer feedback – e.g. by smartphone apps that communicate on the sustainability performance of products. This can hamper the barriers of consumer-producer interaction to urban agriculture development (see *chapter 5.2.*) – guiding consumers to stray away from vicious low-pricing cycles.

Actors within the *incremental optimisation* showed a critical eye towards urban agriculture being heralded as the go-to alternative for conventional agriculture. The agricultural employers organisation stated continuous research on sustainability aspects of alternative food systems is necessary. This is rightfully questioned since e.g. retrofitting vacant buildings for crop production does not yet seem a clear sustainable alternative to land production (Spruijt, 2015). The interviewee active in top sectors policy did not address learning processes for urban agriculture itself. However, international business and government collaboration was mentioned essential in reaching sustainable food systems. Their approach actively encourages learning between different sectors – e.g. food, logistics, chemical industries and water management (Ministerie van Economische Zaken, 2015).

6.6. *Broaden participation*

This resilience principle contemplates that broad participation stimulates trust and opens up dialogue between various types of actors in society. This provides capacity building to effectively manage socio-ecological systems. Urban agriculture portrays such participation via building social cohesion in community gardens. The interviewees within the *socio-educational* discourse mentioned the historic function of urban gardens and allotments in stimulating cultural interaction and aiding immigrants with their integration into new societies.

Inclusion of a wide range of perspectives is moreover useful when emerging systems (such as urban agriculture) are still in an early stage of development. Early participation of diverse stakeholders offers the means to address specific needs, priorities and tasks before a system crystallises. The municipality interviewee acknowledged this by aiming to assemble urban agriculture networks by which stakeholders can easily find and connect with relevant others. In the Netherlands, a countrywide network already provided a massive boost for urban agriculture by actively sharing visions, challenges and solutions. Having an online platform and setting up real-life meetings, this network aims to effectively transform urban agriculture from its niche towards a mainstream practice (Jansma, 2015). Municipalities further view urban agriculture projects as living labs – by which citizens are stimulated to participate and co-innovative to come up with solutions for urban sustainability issues (Bergvall-Kareborn, 2009; Voytenko, to be published). As already mentioned in the previous sub-chapter, the *regime changing* discourse emphasises peer-to-peer technology potential and the *incremental optimisation* discourse advocates for international business and governmental collaboration. Both are also aimed at broadened participation.

Pioneering decentralised market initiatives furthermore mentioned that through commercialised urban agriculture, capital flow stays within close geographical proximity. This creates a positive internal feedback, boosting local economies. Participation in local development can then be broadened through sprouting entrepreneurship opportunities and job creation. Some of these market initiatives mentioned they were (partly) funded through shared ownership. This is heralded by these initiatives to improve the business by creating trust, active feedback and enthusiasm among its shareholders – while the economic cooperation simultaneously functions as shielding mechanism to guarantee business survival (see *chapter 5.2.*).

6.7. *Promote polycentric governance systems*

This resilience principle contemplates that multiple interacting governing bodies (institutions and actor types) should be included in decision-making processes to adequately respond to system disturbances. This enables continuous collaboration, learning and specific stakeholders to be consulted when necessary. Rotmans (2012) advocates that shifting from centralised to decentralised, flat governance is necessary for sustainable food system transition. Similarly to the statements within the *regime changing* discourse, horizontal power structures are argued to provide democracy by inclusion of (local) governments, decentralised market initiatives and bottom-up participators in decision-making processes. Urban gardeners within the *socio-educational* discourse mention their projects not being framed relevant enough in decision-making and seek inclusion. Polycentrism allows the flexibility to overcome such limiting factors by inert bureaucracy and organisational structures (see *chapter 5.4*.) This strays food systems away from top-down decision-making by transcending traditional party affiliations. Interviewees within the *incremental optimisation* discourse mentioned collaboration across scales (albeit in a more enabling manner, e.g. stimulating projects in developing countries) but did not seem to stress the need of shifting decision-making processes away from verticality.

Giving local governments more autonomy is another characteristic of polycentrism. The municipal interviewee acknowledged this by assembling networks for urban agriculture (as portrayed throughout the previous principle). Moragues (2013) describes several case studies where polycentrism shined through. To stimulate urban food systems it calls upon integrative governance structures by forming e.g. food policy councils, partnerships, steering groups and food boards. All could be generally described as polycentric networks for managing food systems. Other literature similarly emphasises that urban agriculture ought to be an integral element of urban planning (e.g. Morgan, 2009; Gemeente Rotterdam, 2012). Recently a food policy pact has been signed by numerous cities throughout the world – which emphasises urban agriculture and the essential role of cities in sustainable food system transitions (Forster, 2015).

7. Discussion

In this research three discourses on urban agriculture have been identified - *socio-educational*, *incremental optimisation* and *regime changing*. These are characterised by specific envisioned sustainable food system states and common issues that might hamper urban agriculture to develop on a larger scale. The insights stemming from this analysis have been used to operationalize resilience for urban agriculture. Discussion of the results is provided in the remainder of this chapter - by comparing the discourses, their implications and validity through comparisons with scientific literature. Reflecting upon applying resilience and how it can stimulate sustainable food system transitions – this finally leads towards methodological limitations and advises for policy and future research on this topic.

7.1. Comparing the discourses and their implications

The basic reasoning on why reshaping the food system is necessary seemed to be agreed upon between the discourses. Safeguarding both global and local food security should occur in the most sustainable manner while a growing world population is challenging the effectiveness of our current food system. Systematic unsustainability in food provision is present and should be avidly tackled and therefore, discussing urban agriculture during the interviews quickly rose what should occur to stimulate sustainable food system transitions. The means to reach these sustainable food systems and the role of urban agriculture herein varied between the discourses.

The *socio-educational* discourse advocates that, in order to reach sustainable food systems (and societies in general) worldviews of society should intrinsically change towards ecologically centred thinking. Urban agriculture is thereby framed as tool that, through its community-oriented gardening practice and organic production, invigorates the weakened link between society and nature. Urban agriculture can furthermore stimulate social cohesion among all facets of society – both cultures and classes. This is argued to create an atmosphere of trust, understanding and respect that is essential to reach sustainable food systems. This discourse thus clearly distinguishes itself from the others, since its focal points firmly operate outside of a market-driven framework. Conventional regime actors might deem abovementioned *socio-educational* drivers of change irrelevant since they cannot be clearly capitalised upon. Yet, this discourse is to

be taken highly seriously when advocating for sustainable (food system) transitions. It has been argued that merely material growth is inadequate for sustainable development (Beddoe, 2009) – while coming to a mutual understanding of worldviews is an essential means to those ends (De Vries, 2009). This discourse thus aims transform the worldviews of society away from dominant market-driven values, by invoking behavioural change via ecologically centred activities such as urban agriculture. Positive relations between behavioural change and stimulating sustainable lifestyles have been thoroughly assessed throughout literature (e.g. social learning and motivational psychology) (Wals, 2007; Gifford, 2011).

The *incremental optimisation* discourse distinguishes itself by advocating for incremental optimisation of status quo practices instead of radical food system change. International business and government cooperation is viewed key to reach sustainable food systems. Interviewees thereby called upon the successes of the conventional food system. Notwithstanding environmental degradation that badly designed conventional systems created, this discourse argued strong proof on the increased sustainability and production performance of alternative food systems should be brought to the table before conventional systems are rejected. Fresco (2015) has a similar vision. In her book, she describes that although alternative forms of agriculture (e.g. organic, urban) have a role in food production awareness – it should not be romanticised as a go-to alternative since it cannot adequately respond to food production demands of a growing world population. Food security and sustainable production are framed as highly complex issues that only conventional, knowledge-intensive sectors can avidly tackle. Therefore, urban agriculture is framed as a “back to basics” approach and deemed irrelevant. Alternative food system advocacy is blamed to stem from parts of society occupying a luxury position (e.g. middle- and upper-classes in the West). Fresco furthermore argues that alternative non-intensive food production systems require high amounts of (physical) labour and community commitment to food production. Not only being less efficient in production output than technological optimisation and intensification – she says this also renders poor communities (especially in developing countries) unable to escape from agricultural lifestyles.

Although their neglect is clear, the actors within the *incremental optimisation* discourse can provide crucial tools for urban agriculture to thrive on a large scale. Incumbent actors (e.g. top sectors) possess the technological know-how, institutional (lobby) power, capital and resource leverage to transform industries, facilitate innovation and

change policies. This might however not seem a plausible scenario, following arguments that the previous paragraph described. Since dominant discourses strongly influence policy trajectories (Hajer, 2005), framing small-scale urban agriculture as an irrelevant element to sustainable food systems could cause public support for alternative food movements to reduce. Urban agricultural benefits to the socio-ecological system are thereby constrained (benefits as widely portrayed throughout this research - self-sufficiency, carbon-neutral green liveable cities, and so on). Being a discourse holding the aces (in terms of abovementioned leverage power), this might also cause capital allocation⁵ for research and development to continue preferring innovations that benefit the conventional regime – by which their position and ideology remains established.

The *socio-educational* discourse seems to fear the latter. Interviewees stated that they feel urban agriculture is currently being hijacked by market-driven and neoliberal ideologies, which negates the educational systems change which their bottom-up practice ought to disperse. Hallock (2013) acknowledges these statements, arguing how neoliberalism created the conditions (class struggle, environmental degradation and inequity in the food system) that gave rise to the current bottom-up urban agriculture trends. As a response to these and other general urbanisation trends, it is sketched how the conventional food regime utilises this market opportunity by adopting capital-intensive urban agriculture (e.g. vertical farms using LED⁶) to remain their dominant position within the food system. Wrapped to the public as green, local businesses highly beneficial to sustainable development, Hallock concludes conventional food regimes are thereby able to paradoxically profit from their self-created systematic flaws.

It could thus be argued that within current regime boundaries, vertical power mechanisms and market structures (e.g. subsidies as portrayed in *chapter 5.2.*) might produce a vicious cycle in which attempts to form alternative (non-market driven) food systems are “usurped” by the conventional regime to maintain their dominance. Adoption of systems-wide change advocated by *socio-educational* discourse actors could be likely to occur under severe crises which render conventional dominance ineffective - e.g. when Cuba massively adopted urban agriculture after experiencing nationwide food

⁵ Dutch governmental capital allocation for research and development is blamed to strongly favor top sectors, which hampers funding towards fundamental research (Europese Commissie, 2012).

⁶ Hallock (2013) and Van der Schans (2015) explain how PlantLab (a Dutch vertical farming pioneer) conducts this type of capitalist urban agriculture with a closed proprietary approach.

insecurity and economic crisis following the Soviet Union collapse (as portrayed in *chapter 6.3.*).

Legitimacy of these two opposing discourses could be solidified, as similar results have been found in a research on spatial planning and sustainable food systems. Broekhof (2010) describes tensions that resemble the abovementioned conflicts between the opposing *socio-educational* and *incremental optimisation* discourses. Its results are drawn from a different research area and methodology - assessing scientific planning journals and best-selling books instead. Yet, it seems to mirror this research in the following. It construes the "dominant conventional global-industrial food systems and the emerging alternative complex of local-organic systems" as thesis and antithesis. These conflicting worlds are separated by an unbridgeable gap in which the emerging systems (e.g. urban agriculture) cannot compete with the conventional regime. This gap for emerging systems is upheld by similar barriers that have been detected in this research (see *chapter 5.*). Broekhof mentions agricultural subsidies, land policy and logistical transportation privilege as such barriers. Agricultural subsidies (in order to compete on global markets) favour conventional food systems due little profit margin stemming from the sales of actual agricultural product. This maintains a privilege position for producers that operate on economies of scale (similar to market structure issues, see *chapter 5.2.*). Land policy idem – producers aiming to enter the market with small-scale local food production are disadvantaged due to high urban property prices. This strongly favours market viability of large-scale production systems located further away from urban areas (similar to property price issues, see *chapter 5.1.*). Logistical transportation privilege is caused by the externalities of long transport chains not being internalised (non-accounted for detrimental costs of carbon emissions and consequent environmental degradation). This favours the conventional regime, which contains the actors that engage in global trade and fossil fuel driven agricultural practices (similar to fossil-fuel lock in issues, see *chapter 5.3.*).

To shape diverse sustainable food systems, Broekhof (2010) concludes with the necessity of a third mediating discourse to broadly develop - which can bridge "the contested middle-ground" between the abovementioned conflicting worlds. This third-way discourse can only start from the bottom-up by embracing and expanding local alternative food systems, since entrenched top-down control (as abovementioned barriers show) most likely renders other approaches ineffective. The *regime changing* discourse traced in this research seems to embrace those middle-grounded aspects.

Several agreements for its mediating functioning are present, but first the dissimilarities are described which clearly distinguishes this discourse from the others.

The *regime changing* discourse disagrees with the *socio-educational* discourse actors upholding a utopian vision of system-wide change in mentality. Although similarly recognising agro-ecology as a highly effective production method and advocating for decentralised alternative food systems, the *regime changing* discourse also disagrees with advocacy for dominant organic production – high-tech systems should be pragmatically implemented (e.g. vertical farms in water-scarce desert biomes). This discourse further rejects their disbelief in technological interventions. Exactly the opposite is advocated for - the *regime changing* discourse views technology as essential to stimulate urban agriculture and sustainable food system transitions. Peer-to-peer technology can effectively enhance continuous critical feedback between consumers to producers. Transparency and awareness are thereby enhanced – which is argued to result in an atmosphere that pushes for sustainable production processes. Feedback further effectively matches supply and demand and optimal use of resources - avoiding inefficiency and waste.

The *regime changing* discourse also disagrees with the *incremental optimisation* discourse in various ways. Incremental optimisation within current regime boundaries (see *chapter 5*) is judged as ineffective to sustainable development. It maintains centralised dominance, globalised markets, opaque production and supply chains that have caused harmful consequences. Horizontal power structures instead of the vertical status quo are essential to food system transition – this enables a wider variety of stakeholders, such as local governments and decentralised food systems to equally partake in decision-making. Furthermore, where the conventional regime businesses are mainly characterised by closed proprietary approaches, the *regime changing* discourse advocates for open innovation. This enhances self-sufficiency of marginalised communities by increased information availability and development opportunities. Openness combined with peer-to-peer technology is argued to be able to outcompete status quo innovation through sharing potential. Ambitious projects are being launched in this sense, using (cloud) data for supply chain optimisation and product innovation (Kaloxylos, 2013; Van der Schans, 2014). Urban agriculture thus ought to be framed as highly important – its cooperative living lab functioning can greatly boost urban sustainable transitions. The *regime changing* further draws upon shared ownership mechanisms to guarantee business survival – this can enable communities to adopt

expensive urban production systems (e.g. vertical farms or purchasing ground for large food gardens) that would otherwise only be attainable by wealthy conventional food regime actors.

Dissimilarities seem clear. Returning to the third-way mediating functioning of this discourse – how exactly can that be achieved? The answer lies in pragmatism. Using a “best of both worlds” approach to mediate is key in stimulating sustainable food systems. To an extent, this discourse similarly adopts mentality-driven approaches of the *socio-educational* discourse - non-economic values are essential to sustainability and the conventional food systems ought to be radically changed towards democracy. To fulfil those ideals, the *regime changing* discourse aims to work within market-driven boundaries instead of waiting for a societal moment of clarity to occur. By theoretically approaching urban agriculture as a niche challenging the conventional food regime, this discourse draws parallels to the schools of thought present in strategic niche management (Kemp, 1998; Schot & Geels, 2008). Through the overlapping market-driven approach to sustainability, a coalition can be formed with the *incremental optimisation* discourse. This discourse coalition could play a pivotal role for urban agriculture to develop on a larger scale. By gaining more influence and dominance – which can happen if *regime changing* discourse propositions provide to be economically viable and more sustainable – markets and policy can conjunctionally be steered towards favourable conditions for urban agriculture. A theoretical model by Hockerts (2009) describes how incumbent actors (inherently less likely to pursue radical alternative business routes due to accompanying high-risk) take cue and respond to successful emerging sustainability-oriented niche markets. Incumbents then pursue similar business activities in the form of corporate sustainable entrepreneurship, in order to stay in business and not be outcompeted by the niches. This process causes positive feedback loops that can transform production sectors towards sustainability.

Aforementioned economic viability and sustainability performance of *regime changing* discourse propositions thus seem essential in convincing the conventional regime actors to stray away from verticality and globalised, subsidised markets. If this is not the case, scenarios with vertical farms (Hallock, 2010) or continued conventional intensification as previously portrayed in this chapter could be likely. If the *regime changing* discourse would succeed in convincing and transforming the conventional regime to move past the detected barriers that hamper urban agriculture (see *chapter 5*) - this can potentially create an atmosphere where *socio-educational* discourse values start to gain more social

momentum as well. The latter scenario could entail a society characterised by a wide emergence of diverse sustainable food systems.

It is therefore interesting what the interplay between these discourses shall entail if discussions around urban agriculture are to increasingly enter politicised arenas. The issue here is that all discourses believe they are “doing the right thing” while posing different approaches and envisioned sustainable food system states. Neither of them possesses a crystal ball to see if their propositions are truly the ones that ought to be pursued. It is therefore time for an integrated approach – leading us to the next chapter.

7.2. *Reflecting upon resilience*

To avoid undesirable food system states, integrated approaches to stimulate the potential of urban agriculture and related phenomena addressing sustainable food system transitions can be regarded necessary. To research these transitions, resilience (e.g. Davoudi, 2012; Biggs, 2015) has been applied – an approach aiming to understand the uncertainties and complexities that are inherent to socio-ecological systems. Operationalizing the seven resilience principles as formulated by Biggs (2015) for urban agriculture, has been conducted successfully (see *chapter 6*). All principles have shown to be applicable to the wide array of claims on urban agriculture and sustainable food system transitions - as detected by re-analysing interview results and key documents through a lens of resilience. Resilience thereby seemed to structurally unravel the wider context upon which urban agriculture and sustainable food system transitions touch – e.g. climate change mitigation, preserving biodiversity, how market forces link with poverty and changing governance structures.

The abovementioned applicability showed that all three discourses seem to embrace the importance of resilience. Indeed, regardless of their propositions, all discourses do have one common goal in mind – aiming to transition towards a sustainable food system. As the previous chapter has shown, the envisioned sustainable food system states do differ between the discourses. In the eye of resilience thinking, this should be viewed upon as a chance and not a barrier – since the inclusion of various knowledge types can provide a multitude of otherwise overlooked solutions to build resilient systems (Biggs, 2012). Resilience thus seems to potentially provide the coherent framework for the discourses to cooperate towards their common goal. In the remainder of this subchapter it will be

sketched how and why applying resilience to urban agriculture could help to pave the pathway towards resilient food systems. To do so, potential resilience-building focal points will be assigned to each discourse.

Starting with the *incremental optimisation* discourse – the actors within this discourse seemed to most specifically touch upon the resilience principles *manage connectivity* and *manage slow variables and feedbacks*. Holding a strong position in conventional regimes and possessing technological knowhow (e.g. top sectors and agricultural employers organisations) – a resilience-building focal point that could be assigned is the stimulation of active collaboration between (conventional) industries and sectors. Another focal point fitting to their propositions is enabling and investing in high-tech (circular) systems, to embed connectivity and monitor complex system variables related to the food system (see *chapter 6.2*). As described in the previous subchapter, this discourse has the resource leverage to facilitate high-tech innovation and circularity between current linear, separated systems⁷. While circularity can lower costs in the long run, implementation and alternation of existing resource-infrastructures is highly expensive and thus would be boosted by dedicated capital allocation from conventional regime actors. For example, radical infrastructural transformation to existing sanitation and sewer systems are argued to be complicated due to such high costs (Mitchel, 2012) - and national and European funding is noted to play an essential role for developing European smart electricity grids (Covrig, 2014). If invested, ecological sanitation can provide the means for circularly sourced fertiliser – while smart grids can help to transition the food system away from fossil fuel lock-in. Moreover, the *incremental optimisation* discourse can strongly influence policies to aid food system transitions past detected barriers - such as issues regarding subsidies, property price and fossil fuel lock-in (see *chapter 5*). To avoid inert bureaucracy and organisational structures, a final focal point would be to include a wide(r) array of stakeholders into decision-making processes - thus embracing polycentrism. It should be stated that this discourse was the only one that did not seem to stress for options related to the principle *promote polycentric governance systems*. Enabling this inclusion and recognition can be regarded as an utmost crucial step for the conventional regime to stimulate resilience.

⁷ It should however not be disregarded that low-tech propositions by the *socio-educational* and *regime changing* discourses also provide circular means to become (largely) self-sustaining at household and community level (Savini, 2015).

The actors within the *incremental optimisation* discourse, similar to the vision by Fresco (2015) as portrayed in the previous subchapter, seem to frame bottom-up alternatives as marginal players in the food system. Viewing *socio-educational* propositions through a lens of resilience, however, provides a contrasting and more promising image. The *incremental discourse* should instead frame bottom-up alternatives as if operating on a resilience-building level on which they themselves do not seem to touch – e.g. (cultural) inclusion, social cohesion, self-sufficiency and ecologically centred education. The *socio-educational* discourse could therefore be assigned resilience-building focal points, which predominantly link to the resilience principles *encourage learning* and *broaden participation*. Examples could be facilitating urban agriculture workshops for primary and high schools as well as (guest) lecturing on eco- and food system complexities. Workshops could also be given in (public) parks that are transformed to food forests or contain urban gardens - teaching citizens how to effectively garden and add up to circularity at household and community level. Extensive knowledge on food production could guide consumers to stray away from low-priced products if they are aware of the environmental impacts the production processes might have caused (see *chapter 5.2.*). Governments and municipalities could furthermore consult *socio-educational* discourse actors to run or aid in immigrant integration programmes.

Krasny (2009) finely portrays the interplay between environmental education and socio-ecological resilience, which could solidify the abovementioned focal points. That research operationalized resilience for community gardening, amongst other educating activities. Two attributes of resilience have been applied in that research - diversity and self-organisation. Krasny links diversity and environmental education by emphasising the positive effects of biodiversity preservation and incorporation of various knowledge types. The *socio-educational* discourse actors also emphasised biodiversity preservation and the role of urban agriculture herein - e.g. by safeguarding pollinators and providing ecological corridors (see *chapter 6.2.*). Agro-ecological and traditional knowledge furthermore provide means to maintain urban ecosystem health. Krasny links the attribute self-organisation to environmental education by emphasising ecosystem services of urban garden. This draws similarities to options addressing climate change and flood proneness (see *chapter 6.3.*). Participatory activities are furthermore mentioned to contribute to systemic self-organisation via social cohesion (e.g. similar to learning and participation in *chapter 6.5.* and *6.6.*). Positive feedback loops to resilience are furthermore mentioned, due to environmental education creating "sense of agency"

for proactive sustainable lifestyles and a "feeling of connectedness to people and to nature".

It cannot be said whether the opposing interplay between the *socio-educational* and *incremental optimisation* discourses (as portrayed in the previous subchapter) will truly occur once urban agriculture is to increasingly enter politicised arenas. No matter what those outcome will be, it could be argued that *regime changing* discourse could best function as a mediator between these two discourses. Since this discourse adheres to both bottom-up value-driven and market-driven approaches, resilience-building focal points could be to maintain a strategic and overarching role in actively guiding sustainable food system transitions. This role seems fit due to the inherent continuous critical nature of several actors within this discourse – pointing to presence of urban agriculture researchers and pioneering decentralised market initiatives. These actors arguably provided the widest array of bottlenecks for sustainable food system transitions (see *chapter 4.2* and *5*) and pragmatic options to overcome them. Simultaneously, this discourse can be regarded as most effective to influence top-down decision-making – pointing to presence of municipal and sustainability consulting governmental actors.

The *regime changing* discourse can thus serve to bridge gaps. Even if consensus between the other two discourses will be present, they still seem to operate on societal levels that do not easily come into contact (e.g. governmental- and business versus community-level). Municipalities and researchers having an apt overview of local urban agriculture, can “translate” the results, knowledge and needs of the *socio-educational* discourse towards conventional actors – and vice versa. By similarly acknowledging agro-ecological potential to ecosystem resilience, the *regime changing* discourse can e.g. convince *incremental optimisation* actors to increasingly allocate property to urban gardens if they can, or alter conventional production processes. Fittingly, the resilience principle *promote polycentric governance systems* was most advocated for by the actors within the *regime changing* discourse. This principle can be seen as a catalyst to the other six principles (Biggs, 2012). Their advocacy for polycentrism showed by actors stating horizontality and democratisation of food systems is necessary to remove the barriers that hamper urban agriculture (see *chapter 5*). Expanding the existing as well as forming new food policy councils can further serve this cause (Moragues, 2013; Forster, 2015). Technological innovations proposed by this discourse can help to *encourage learning* and *broaden participation* – potentially leading to transparency, product

optimisation and matching supply with demand. By promoting product diversity, monocultures and their negative consequences can be mitigated. If pursuing these resilience-building options leads to success of pioneering decentralised market initiatives, conventional markets are stimulated to exert similar behaviour to maintain a competitive market position - as portrayed in the previous subchapter via the model of Hockerts (2009),

As thus far described throughout the previous paragraphs, applying resilience seems to be well able in positively stimulating urban agriculture and sustainable food system transitions. However, it is also important to critically reflect upon its applicability. While resilience may provide a coherent framework to elucidate debates and assign fitting resilience-building focal points – slight ambiguity can arise due to its broad applicability and interpretability. Indeed, these results of qualitative nature do not exactly pinpoint or weigh what options are preferable to be pursued in practice. As discussed before, envisioned sustainable food system states seem to differ between the discourses. While it is unclear how the interplay between them will turn out once urban agriculture increasingly enters politicised arenas, applying resilience should be done with patience and care to avoid social complexities that hamper sustainable food system transitions.

For example – if through broadened participation and polycentrism, *socio-educational* and *incremental optimisation* discourse actors enter debates, this does not necessarily mean shared understanding and trust is built. If propositions remain in conflict and the *regime changing* discourse cannot mediate, this could potentially cause dominant actors to revise and thereby revert from polycentrism and transparency in decision-making. Davoudi (2012) also warns for related limitations – describing how desirable system outcomes of applying resilience could be subject to normative judgements. However, it is mentioned that the strength of socio-ecological “evolutionary” resilience lays avoiding systemic deadlocks, since it rejects the notion of equilibrium due to the inherent uncertainties and dynamic interplay of socio-ecological systems. Simultaneously, this approach is argued to bridge natural and social sciences, stimulating interdisciplinary collaboration and dialogue. Optimism should thus prevail since, similarly to the elaboration within this subchapter, resilience seems to be able to provide an attractive framework – one that utilises all discourses in sustainable food system transitions by drawing upon their fields of expertise.

7.3. *Methodological limitations and advise for future research*

Notwithstanding the insights that the results and consequent discussion have produced, it is important to critically reflect upon the limitations and bias of the methodological approach. This can assess whether the results of this research uphold in a wider context and thereby provide advice for future research and policy regarding urban agriculture and sustainable food system transitions.

A first limitation seems to be that urban agriculture is still in a relatively emerging phase. Due to this, the steps recommended by Hajer (2005) for *argumentative discourse analysis* have been slightly altered in such a way that in-depth interviews were the main sources of data - opposed to analysing debates. Throughout the discussion it has therefore been stressed that these results should be perceived as preliminary and with caution, since the discourses and their interplay sketched might not be correct once urban agriculture is to increasingly enter politicised arenas - even if the comparisons with literature seemed to solidify their validity. Moreover, interviews (despite fixed theme topics) are an one-take unique measure which could be highly determined by external factors - e.g. time limitation, course of conversation or mood of the interviewee.

A second limitation to the wider applicability of the results could be related to the geographical sample area the interviews have been conducted in - the Netherlands. Especially the Randstad area within this country can be regarded as a large agglomeration, where agricultural land connects its (small) cities. Therefore, it could be argued that supply chains are relatively short compared to other countries (albeit for national production) and that food deserts do not occur. Being a food secure country, these aspects combined could have created a framing bias among some interviewees. This bias could have reduced the perceived importance and added value of urban agriculture to sustainable food system transitions. To sketch this, countries with high poverty rates might increasingly stress for the functioning of small-scale urban agriculture by which communities and households can become self-sufficient. Conventional regime actors might be more enthusiastic about urban production systems if they operate in a larger country with relatively less agricultural land close to cities.

A third limitation could be that the seven resilience principles by Biggs (2015) have not been explicitly discussed during the in-depth interviews. If this would have been done, the interviewees might have provided unprecedented insights for the operationalization

of resilience. For example, the interviewees might have exerted more concrete options relating to each principle - and thereby which focal points various actors ought to embrace to make food systems more resilient.

A fourth limitation could arise through potential missed insights, since not all relevant stakeholder types found through snowballing were able to conduct interviews with. Conventional retailers (e.g. supermarkets and mediating retailers) might have provided relevant insights relating to possible transformation of the conventional market regime towards alternative local production systems. Vertical farms using LED-lights might have provided unique insights since some of these companies are facilitating capital-intensive production and closed proprietary innovation within an urban setting – such as the companies assessed by Hallock (2013; see *chapter 7.1*).

Future discourse analysis on urban agriculture and its relation to sustainable food systems should therefore include these stakeholders – as well as several others that seem to be illuminated in this research. Since urban agriculture seems to be hampered by several barriers (see *chapter 5*) – e.g. interviewing European Commission members of the Agriculture and Rural Development department might provide insights in how subsidy-dependence can be negated. Another example could be interviewing experts in climate change policy or climatic economics to provide insights in how internalising (environmental) externalities in product prices can negate the barrier of fossil fuel lock-in. Repeating the geographical bias, it is therefore advised to conduct similar discourse analyses in other countries to gain more insights in location-specific discourse interplay as well as checking the validity of the identified discourses from this research. Repeating limitation by alternation of the methodological steps recommended by Hajer (2005) – it be furthermore advised to conduct his original approach once more concrete politicised debates around urban agriculture emerge.

It is hereby also advised for researchers and policymakers alike to arrange such integrated debates. Doing so during this emerging state that urban agriculture still resides in, could provide early warnings to avoid potential negative impacts of food system transitions. Workshops with relevant stakeholders could be organised to discuss their envisioned sustainable food system states, transition processes and what resilience entails for them. This could help to create a shared understanding among the participants – which is a first step towards polycentrism. Moreover, the resilience-

building focal points as have been discussed in the previous subchapter could then be more specifically formulated and assigned.

For policymakers it is therefore advised to utilise the multifaceted nature of urban agriculture to strengthen (urban) sustainability - and act upon this through integrated approaches such as resilience. Municipalities could experiment with resilience frameworks in policymaking – operationalizing it for urban agriculture within their cities. Food policy councils could similarly apply resilience to foster widespread knowledge on (urban) sustainable food system transitions – e.g. among the cities that have signed the Milan Urban Food Policy Pact (Forster, 2015). Last but not least, it is important to continuously conduct (fundamental) research on the environmental and socio-economic impacts of the propositions exerted by the interviewees – for aiding decision-making towards resilience food systems.

8. Conclusion

This research provided a pioneering attempt by which to stimulate food system transitions - starting from the notion that there are several flaws in our food system that cause severe (socio-) ecological harm. Thereby, it was noted that the emerging concept of urban agriculture is being heralded as a useful tool to mitigate these flaws. Since urban agriculture is practiced in various forms and being discussed in multiple facets of society – it was therefore argued that various discourses on urban agriculture might be present. Assessing these was regarded important since discourse analysis could illuminate useful insights on stimulate sustainable food system transitions. Resilience was argued to aid in structurally unravelling these transitions – by assessing to what extent the propositions from discourse analysis influence socio-ecological system dynamics of the food system.

After a series of in-depth interviews and document research, the main research question this research aimed to answer therefore stated: *“What insights do urban agriculture discourses and resilience thinking provide for understanding food system transitions?”*.

To answer this, the first sub-question stated: *“What discourses on urban agriculture and its relation to sustainable food system transitions can be identified among various relevant stakeholders?”*. The three discourses that have been identified are characterised by their

(1) *socio-educational*, (2) *incremental optimising* and (3) *regime changing* emphasis. The first advocated for a systems wide change in mentality, framing urban agriculture as a tool that could stimulate ecologically centred thinking through participation and consequent social cohesion. The second advocated for the high potential of international business and governmental collaboration to safeguard food security. Urban agriculture seemed to be mainly framed as a symbolic activity. The third advocated for a regime change, since the boundaries set by conventional regimes are argued to strongly hamper sustainable food system transitions. Urban agriculture was thereby framed as a clear characteristic of a transitioning society towards horizontality and democratisation of the food system - in which open technological innovation plays a large role.

The second sub-question stated: "*What are the issues hampering urban agriculture to develop on a larger scale?*". Although envisioned sustainable food system states differed between the discourses – four common issues were identified. These issues relate to (1) *land and property price*, (2) *market structure and its effect on producer-consumer interaction*, (3) *fossil fuel-lock in*; and (4) *bureaucracy and organisational structures*. The former two heavily relate to subsidy-strained markets and consequent economies of scale that provide competitive advantages for conventional food regimes. The latter two relate to issues that hamper sustainable development in more general sense – pointing to externalities not being internalised in (product) prices; and negative consequences of opaque decision-making processes in vertical power structures, respectively.

The third sub-question stated: "*What does operationalizing resilience for urban agriculture entail?*". Operationalization of resilience indeed seemed to structurally unravel the wider context upon which urban agriculture and sustainable food system transitions touch. Such socio-ecological systemic aspects entail e.g. climate change mitigation, preserving biodiversity, how market forces link with poverty, knowledge transfer and changing governance structures. Synthesis of the results through discussion and comparison with literature have led to the following conclusions by which to answer the main research question:

Although opposing propositions on envisioned sustainable food system states could impede collaboration between discourses once urban agriculture enters more concrete politicised arenas, applying resilience can well act as an integrated tool to overcome those differences. Resilience-building focal points can then be assigned to utilise all discourses within food system transitions, by drawing upon their fields of expertise. The

socio-educational discourse is advised to focus on environmental education and learning through participatory activities, providing often-overlooked knowledge to ecological circularity at the bottom-up level. The *incremental optimisation* discourse is advised to negate the barriers hampering urban agriculture through policy. Cross-sectorial collaboration and investment in circular infrastructures can maintain slow variables and feedbacks within socio-ecological systems. The *regime changing* discourse is advised to overarch and structurally guide polycentric governance – acting as a mediator between the other two opposing discourses by adhering to both value- and market-driven approaches. Continuously challenging conventional regimes through radical innovation can steer society towards sustainability. However, fundamental and applied research is necessary to validate and expand on the propositions sketched throughout this research – e.g. through focus groups that lead to discussions between the actors from the three discourses, and what resilient food systems entail for them. To finish, it can be regarded that continuous collaboration and optimism are the most essential aspects to pave the pathway towards the common envisioned goal - sustainable and resilient food systems.

References

- Altieri, M. A., Companioni, N., Cañizares, K., Murphy, C., Rosset, P., Bourque, M., & Nicholls, C. I. (1999). The greening of the “barrios”: Urban agriculture for food security in Cuba. *Agriculture and Human Values*, 16(2), 131-140.
- Ashley, K., Cordell, D., & Mavinic, D. (2011). A brief history of phosphorus: From the philosopher’s stone to nutrient recovery and reuse. *Chemosphere*, 84(6), 737-746.
- Barthel, S., Folke, C., & Colding, J. (2010). Social–ecological memory in urban gardens—Retaining the capacity for management of ecosystem services. *Global Environmental Change*, 20(2), 255-265.
- Barthel, S., & Isendahl, C. (2013). Urban gardens, agriculture, and water management: sources of resilience for long-term food security in cities. *Ecological Economics*, 86, 224-234.
- Beddoe, R., Costanza, R., Farley, J., Garza, E., Kent, J., Kubiszewski, I., ... & Ogden, Z. (2009). Overcoming systemic roadblocks to sustainability: The evolutionary redesign of worldviews, institutions, and technologies. *Proceedings of the National Academy of Sciences*, 106(8), 2483-2489.

Bergvall-Kareborn, B., & Stahlbrost, A. (2009). Living Lab: an open and citizen-centric approach for innovation. *International Journal of Innovation and Regional Development*, 1(4), 356-370.

Biggs, R., M. Schlüter, D. Biggs, E.L. Bohensky, S. Burnsilver, G. Cundill, V. Dakos, T. Daw, L. Evans, K. Kotschy, A. Leitch, C. Meek, A. Quinlan, C. Raudsepp-Hearne, M. Robards, M.L. Schoon, L. Schultz and P. C. West. (2012). Towards principles for enhancing the resilience of ecosystem services. *Annual Review of Environment and Resources* 37: 421-448.

Biggs, R., Schlüter, M., & Schoon, M. L. (Eds.). (2015). *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems*. Cambridge University Press.

Brinkman, H. J., & Hendrix, C. S. (2011). *Food Insecurity and Violent Conflict: Causes, Consequences, and Addressing the Challenges, World Food Programme*.

Broekhof, S., & van der Valk, A. (2010). Planning and the quest for sustainable food systems. Explorations of unknown territory in planning research. *Viljoen, A.; Wiskerke, JSC (2012), Sustainable Food Planning. Evolving theory and Practice. Wageningen: Wageningen Academic Publishers*, 393-404.

Carpenter, S., B. Walker, J.M. Anderies, N. Abel (2001). From metaphor to measurement: resilience of what to what? *Ecosystems*, 4, 765-781.

Clemencon, R. (2016). The Two Sides of the Paris Climate Agreement: Dismal Failure or Historic Breakthrough? *The Journal of Environment Development* March 2016 vol. 25 no. 13-24.

Cohen D.; Crabtree B.; 2006 "Qualitative Research Guidelines Project." July 2006.

Colding, J., Lundberg, J., & Folke, C. (2006). Incorporating green-area user groups in urban ecosystem management. *AMBIO: A Journal of the Human Environment*, 35(5), 237-244.

Cordell, D., Rosemarin, A., Schröder, J. J., & Smit, A. L. (2011). Towards global phosphorus security: A systems framework for phosphorus recovery and reuse options. *Chemosphere*, 84(6), 747-758.

Cordell, D., Drangert, J. O., & White, S. (2009). The story of phosphorus: global food security and food for thought. *Global environmental change*, 19(2), 292-305.

Covrig, C.F.; Ardelean, M.; Fulli, G.; Sanchez; Jimenez, M.; et al. (2014). *Smart Grid Projects Outlook 2014*. European Commission. JRC-ENER Report EUR 26651 EN- Joint Research Centre - Institute for Energy and Transport.

Cummins, S., & Macintyre, S. (2006). Food environments and obesity—neighbourhood or nation?. *International journal of epidemiology*, 35(1), 100-104.

Davoudi, S. (2012). Resilience: A Bridging Concept or a Dead End? *Planning Theory & Practice* 13 (2) 299–333.

Dean, T.J. (2013). *Sustainable Venturing: Entrepreneurial Opportunity in the Transition to a Sustainable Economy*. International Edition. Pearson: Boston.

Deelstra, T., & Girardet, H. (2000). Urban agriculture and sustainable cities. Bakker N., Dubbeling M., Gündel S., Sabel-Koshella U., de Zeeuw H. Growing cities, growing food. Urban agriculture on the policy agenda. Feldafing, Germany: Zentralstelle für Ernährung und Landwirtschaft (ZEL), 43-66.

Despommier, D. (2009). The rise of vertical farms. *Scientific American*, 301(5), 80-87.

De Vries, B. J., & Petersen, A. C. (2009). Conceptualizing sustainable development: An assessment methodology connecting values, knowledge, worldviews and scenarios. *Ecological Economics*, 68(4), 1006-1019.

Europese Commissie (2012). Beoordeling van het nationaal hervormingsprogramma 2012 en het stabiliteitsprogramma 2012 voor Nederland. Brussel, 30.5.2012 SWD(2012) 322 final.

Feenstra, G. (2002) Creating space for sustainable food systems: lessons from the field, *Agriculture and Human values*, 19(2): 99 – 106

Fischer, F. *Evaluating Public Policy*, Nelson-Hall, Chicago, 1995.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global environmental change*, 16(3), 253-267.

Forster, T., Egal, F., Renting, H., Dubbeling, M., Getz Escudero, A. (2015). *Milan Urban Food Policy Pact. Selected Good Practices from Cities*. Fondazione Giangiacomo Feltrinelli. ISBN 978-88-6835-221-9.

Fresco, L. O. (2015). *Hamburgers in Paradise: The Stories Behind the Food We Eat*. Princeton University Press.

Galt, R. E., Gray, L. C., & Hurley, P. (2014). Subversive and interstitial food spaces: transforming selves, societies, and society–environment relations through urban agriculture and foraging. *Local Environment*, 19(2), 133-146.

Giampietro, M., Bukkens, S. G., & Pimentel, D. (1994). Models of energy analysis to assess the performance of food systems. *Agricultural Systems*, 45(1), 19-41.

Gemeente Amsterdam (2015). *Stadslandbouw. Voedsel en Amsterdam - Een voedselvisie en agenda voor de stad.*

Gemeente Rotterdam (2012). *Food & the City. Stimuleren van stadslandbouw in en om Rotterdam. Stadsontwikkeling, afdeling Stedenbouw Rotterdam.*

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, 66(4), 290.

Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: the role of the green infrastructure. *Built Environment (1978-)*, 115-133.

Gladek, E., M. Witkamp, P. de Sterke, T. Bosschaert (2011). *Voedsel voor de Stad. Utrecht: Except – Integrated Sustainability. CC-BY-SA-NC 2010. Innovatienetwerk.*

Gladek, E. (2011). *Polydome: high performance polyculture systems. Utrecht: InnovatieNetwerk.*

Gleick, P. H. (2000). A look at twenty-first century water resources development. *Water International*, 25(1), 127-138.

Goddard, M. A., Dougill, A. J., & Benton, T. G. (2010). Scaling up from gardens: biodiversity conservation in urban environments. *Trends in Ecology & Evolution*, 25(2), 90-98.

Goddard, M. A., Dougill, A. J., & Benton, T. G. (2013). Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes. *Ecological Economics*, 86, 258-273.

Grubb, M. (2004). *Technology Innovation and Climate Change Policy: an overview of issues and options. Keio economic studies*, 41(2), 103-132.

Hajer, M. (2005), "Coalitions, practices and meaning in environmental politics: from acid rain to BSE", in Howarth, D. R., & Torfing, J. (2003). *Discourse theory in European politics. Palgrave Macmillan, London*, pp. 297-315.

Hajer, M., & Versteeg, W. (2005). A decade of discourse analysis of environmental politics: achievements, challenges, perspectives. *Journal of environmental policy & planning*, 7(3), 175-184.

Hajer, M. (1995) *The politics of environmental discourse: Ecological modernization and the policy process*, Oxford, Clarendon Press.

Hallock, Lindsey Sarann. (2013). "*Vertical Farms, Urban Restructuring and The Rise of Capitalist Urban Agriculture*". *Agrarian and Environmental Studies (AES)*.

Harris, K. (2011). Resilience in Practice. Operationalising the Ten Characteristics of Resilience Through the Case of Greening Darfur.

Hockerts, K., & Wüstenhagen, R. (2009). *Greening Goliaths versus Emerging Davids*. CBS Center for Corporate Social Responsibility.

Hendrickson, D., Smith, C., & Eikenberry, N. (2006). Fruit and vegetable access in four low-income food deserts communities in Minnesota. *Agriculture and Human Values*, 23(3), 371-383.

IPCC (2014). Summary for policymakers. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

Jansma, J. E., Veen, E. J., van de Kop, P. J., & van Eijk, O. N. M. (2015). Dutch City Network feeds the Innovation of Urban Agriculture. *Urban Agriculture Magazine*, 28, 38-41.

Kaloxylas, A., Wolfert, J., Verwaart, T., Terol, C. M., Brewster, C., Robbemond, R., & Sundmaker, H. (2013). The use of Future Internet technologies in the agriculture and food sectors: integrating the supply chain. *Procedia Technology*, 8, 51-60.

Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology analysis & strategic management*, 10(2), 175-198.

Krasny, M. E., & Tidball, K. G. (2009). Applying a resilience systems framework to urban environmental education. *Environmental education research*, 15(4), 465-482.

Levin, C., Armar-Klemesu, M., Ruel, M., Morris, S., & Ahiadeke, C. (2000). Urban livelihoods and food and nutrition security in Greater Accra, Ghana. Washington, DC: International Food Policy Research Institute.

Lin, B. B., & Fuller, R. A. (2013). FORUM: Sharing or sparing? How should we grow the world's cities?. *Journal of Applied Ecology*, 50(5), 1161-1168.

Lin, B. B., Philpott, S. M., & Jha, S. (2015). The future of urban agriculture and biodiversity-ecosystem services: Challenges and next steps. *Basic and Applied Ecology*, 16(3), 189-201.

McClintock, N. (2010). Why farm the city? Theorizing urban agriculture through a lens of metabolic rift. *Cambridge Journal of regions, economy and society*, rsq005.

McClintock, N. (2014). Radical, reformist, and garden-variety neoliberal: coming to terms with urban agriculture's contradictions. *Local Environment*, 19(2), 147-171.

Ministerie van Economische Zaken (2015). Sectoren in beeld. Jaarbericht sectoren 2015. Februari 2015. Rijksoverheid Nederland.

Mitchell, C., Fam, D., & Cordell, D. (2012). Effectively managing the transition towards restorative futures in the sewage industry: a phosphorus case study. *Water sensitive cities*, 83-96.

Mok, H. F., Williamson, V. G., Grove, J. R., Burry, K., Barker, S. F., & Hamilton, A. J. (2014). Strawberry fields forever? Urban agriculture in developed countries: a review. *Agronomy for sustainable development*, 34(1), 21-43.

Moragues, A.; Morgan, K.; Moschitz, H.; Neimane, I.; Nilsson, H.; Pinto, M.; Rohrer, H.; Ruiz, R.; Thuswald, M.; Tisenkopfs, T. and Halliday, J. (2013) Urban Food Strategies: the rough guide to sustainable food systems. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287)

Morgan, K. (2009) Feeding the City: The Challenge of Urban Food Planning, *International Planning Studies*, 14:4, 341-348, DOI: 10.1080/13563471003642852

Muynck, De, A. (2011). Stadslandbouw en duurzame gebiedsontwikkeling. Erasmus University.

Paginu, V., Struchiner, L. G., Pursiainen, A. K., Eijden, S. V., Yang, Y., Mels, A. R., & Vera, A. (2010). Changing from linear to circular metabolism: Re-Design of an Existing neighborhood in Wageningen, The Netherlands. In *SB10 Western Europe-Toward 0-Impact Buildings and Environments: The Euregion Facing a Second Transition, Maastricht, The Netherlands, 11-13 October 2010*.

Paxton, A. (1994) *The food miles report—the dangers of long-distance food transport*. Sustainable Agriculture Food and Environment Alliance, London, UK

Pearson, L. J., Pearson, L. & Pearson, C.J. (2010) Sustainable urban agriculture: stocktake and opportunities, *International Journal of Agricultural Sustainability*, 8(1-2): 7 – 19

Pfeiffer, D. A. (2013). *Eating fossil fuels: oil, food and the coming crisis in agriculture*. New Society Publishers.

Quinlan, A. E., Berbés-Blázquez, M., Haider, L. J., & Peterson, G. D. (2015). Measuring and assessing resilience: broadening understanding through multiple disciplinary perspectives. *Journal of Applied Ecology*.

Ravallion, M. (2001). *On the urbanization of poverty*. World Bank Development Research Group, Policy Research Working Papers No. 2586. Washington, DC: World Bank.

Rotmans, J., & Horsten, H. (2012). *In het oog van de orkaan: Nederland in transitie*. Uitg. Aeneas.

Ruel, M. T., Garrett, J. L., Hawkes, C., & Cohen, M. J. (2010). The food, fuel, and financial crises affect the urban and rural poor disproportionately: a review of the evidence. *the Journal of Nutrition*, 140(1), 170S-176S.

Runhaar, H., Dieperink, C., & Driessen, P. (2006). Policy analysis for sustainable development: The toolbox for the environmental social scientist. *International Journal of Sustainability in Higher Education*, 7(1), 34-56.

Santos, F. M. (2012). A positive theory of social entrepreneurship. *Journal of business ethics*, 111(3), 335-351.

Savini, F., Verschuuren, S., Salet, W., & Raats, K. (2015). *Master studio urban planning 2014-2015: urban metabolism*. Amsterdam: Department of Human Geography, Urban Planning and International Development Studies, University of Amsterdam. Amsterdam Institute for Social Science Research (AISSR).

Schiffrin, D., Tannen, D., & Hamilton, H. E. (Eds.). (2008). *The handbook of discourse analysis*. John Wiley & Sons.

Schot, J., & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management*, 20(5), 537-554.

Spruijt, J., Jansma, J. E., Vermeulen, T., de Haan, J. J., & Sukkel, W. (2015). *Stadslandbouw in kantoorpanden: Optie of utopie?* (No. 623). PPO-AGV.

Solér, C. (2012) Conceptualizing sustainably produced food for promotional purposes: asustainable marketing approach, *Sustainability*, 4(3): 294 – 340.

Tilman, D., Cassmann, K.G., Matson, P.A., Naylor, R. & Polasky, S. (2002) Agricultural sustainability and intensive production practices, *Nature*, 418(6898): 671 – 677

UNDESA (2013). United Nations, Department of Economic and Social Affairs, Population Division World Population Prospects: The 2012 Revision, Highlights and Advance Tables. Working Paper No. ESA/P/WP.228.

UNDESA (2014). United Nations, Department of Economic and Social Affairs, Population Division. World Urbanization Prospects: The 2014 Revision, Highlights. ST/ESA/SER.A/352) New York: United Nations.

UNFPA, U., & UN-HABITAT, I. O. M. (2013). Population dynamics in the post-2015 development agenda: Report of the global thematic consultation on population dynamics. United Nations.

Van der Schans, J.W.; Renting, H.; van Veenhuizen, R. (2014). Innovations in Urban Agriculture. *Urban Agriculture Magazine*. RUAF.

Van der Sluijs, J. (2003). RIVM/MNP guidance for uncertainty assessment and communication: Detailed guidance (RIVM/MNP Bilthoven; Utrecht University).

Veenhuizen, R.V. (2006). *Cities farming for the future: Urban agriculture for green and productive cities*. IDRC., Philippines.

Voytenko, Y., McCormick, K., Evans, J. & Schliwa, G. (to be published) Urban Living Labs for Sustainability and Low Carbon Cities in Europe: Towards a Research Agenda. *Journal of Cleaner Production*.

Walker, B., C.S. Holling, S.R. Carpenter, A. Kinzig (2004). Resilience, adaptability and transformability in social-ecological systems. *Ecology & Society*, 9 (2), 5.

Wals, A. E. (Ed.). (2007). *Social learning towards a sustainable world: Principles, perspectives, and praxis*. Wageningen Academic Pub.

Wardekker, J. A., Petersen, A. C., & van Der Sluijs, J. P. (2009). Ethics and public perception of climate change: Exploring the Christian voices in the US public debate. *Global Environmental Change*, 19(4), 512-521.

Wardekker, J. A., de Jong, A., Knoop, J. M., & van der Sluijs, J. P. (2010). Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. *Technological Forecasting and Social Change*, 77(6), 987-998.