SOLINSA
Support of Learning and Innovation Networks for Sustainable Agriculture

Agricultural Knowledge Systems In Transition:
Towards a more effective and efficient support of Learning and Innovation Networks for Sustainable Agriculture

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SOLINSA – WP8

REPORT ON THE REVISED CONCEPTUAL FRAMEWORK

LEARNING AND INNOVATION NETWORKS FOR SUSTAINABLE AGRICULTURE

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Executive summary

This Report on the Revised Conceptual Framework will be of interest to researchers addressing learning and innovation in agricultural networks, in innovation as a socio-technical transition and in the social construction of sustainability, as well as those interested in the more specific issues of methodology of multi-stakeholder network research and specifics of support activities for complex learning and innovation networks.

1. LINSA as a special type of network in sustainable agriculture

LINSA allow social innovation through different types of network. They can develop as communities of practice (CoP), networks of practice (NoP), constellations of practice or webs of actors. They can fall within or outside of the conventional AKS and can be incremental or radical innovators (Section 1.1).

LINSA embrace producers, consumers, experts, NGOs, SMEs, local administrations and components of the formal AKS that are mutually engaged with common goals for sustainable agriculture and rural development - cooperating, sharing resources and co-producing new knowledge by creating conditions for communication (1.2).

LINSA are diverse and complex in form and structure and, in the empirical study, were grouped into those that are consumer, non-food or agriculturally oriented networks. They vary in their degree of formality, modes of learning, size and degrees of consensus. They can overlap. They tend to have 'flat' and egalitarian organisational structures (1.3).

LINSA grow for knowledge, economic and accreditation reasons. As they grow they tend to formalise but not all LINSA wish to become mainstream (1.4).

LINSA can have a strong relationship with the AKS or not be connected to the AKS at all; or a relationship that lies between these extremes (1.5).

LINSA require some commonality of view, shared innovation goals, the commitment of members, some level of governance and an embodied connection between innovation and sustainability (1.6).

2. Learning, innovation and sustainability in LINSA

Theoretically, individual, social and organisational processes of learning can be addressed through the actor-network approach which is valuable for understanding how learning is negotiated between different actors. Learning also can be addressed through social learning theories and communities of practice, within which boundary objects can be explored. Innovation can be radical or incremental, top-down or bottom up (2.1)

Learning is important, but its focus varies between LINSA and needs change as the LINSA develops. Forms of learning between LINSA are different and change over time. Individual learning predominates in most LINSA. Social learning is interactive, experiential, peer to peer, and varies in formality. Organisational

learning commonly involves outside organisations. There can be several of these forms of learning within any one LINSA (2.2).

Learning becomes more diverse, the more diverse the constituency of the LINSA. Diversity (and complexity) must be balanced with commonality otherwise the LINSA might become unstable. Co-ordination can help this balance and LINSA have been observed to be uncoordinated, have limited co-ordination or be fully co-ordinated. As LINSA become more formalised, learning tends to be more co-ordinated. Co-ordination can address how inclusive or exclusive learning is. Internet learning is seen as inclusive (2.2).

Innovation paths in a LINSA are influenced by its origin or starting point. Innovation is most likely to be successful when bottom up and top down drivers are convergent and where networks are integrated. Open networks can be more innovative than closed ones and a diversity of stakeholders in a network can stimulate innovation. These latter two factors can stimulate radical innovation. Radical and incremental innovation may be at different points on the same innovation path as innovation changes over time. As LINSA develop and become more formalised their ability to disseminate innovation improves. (2.3).

Sustainability as a concept is considered to be reflexive, inclusive and context dependent with different interpretations in different LINSA. Most however embrace social, economic, technical, multifunctional and environmental factors in a combination of ways. Sustainability goals can be either implicit or explicit. (2.4).

Sustainability meanings are often negotiated (and renegotiated over time) in the context of innovation, learning (and relearning) and the interpretation of knowledge, in an iterative way. Learning is felt to be the most important element of these relationships, but it does not axiomatically lead to improved sustainability behaviour (2.5).

3. Boundary objects and boundary work as analytical tools for examining learning and innovation processes in LINSA

Boundary objects are organising elements of social learning. They can be artefacts, discourses or processes and are created as part of the learning and innovation process (3.1).

Multi-actor interactions and the co-construction of meanings are central to hybrid agricultural learning. In this context, boundary work that helps to achieve LINSA goals is multifunctional, with a diversity of actors, but each LINSA is different. Boundary work can embrace encounters, practice and specific work. Increasingly, boundary work is virtual (3.2).

In LINSA learning, boundaries have to be negotiated between various knowledge bases, attitudes and learning forms. Boundary work and boundary objects evolve as networks develop. Boundary work and boundary objects are instrumental in consolidating innovation. They help internal integration in the LINSA, the mobilisation of external supporters and the adjustment of network goals. Boundary work also is used to accommodate different attitudes towards

sustainability (3.2).

4. LINSA and socio-technical change towards sustainable agriculture and rural development

Socio-technical transitions can be used to explore the drivers and barriers of innovation, and 'framing' can be used to explain motivation for change and its realisation. In these contexts, change relating to LINSA can be seen in simultaneous membership of different networks; the desire to belong to a specific community; political and policy changes, economic, social and natural shocks and social movements (4.1).

LINSA tend to be niche or novelty projects at the margin of mainstream agriculture but others may impact at a regime level. They all undertake some form of transition from their inception and fit well into the policy rhetoric of trying to make agriculture in general more sustainable. It is often necessary for LINSA to begin outside of mainstream agriculture in order to infuse sustainable actions within it. Such LINSA invariably have a broader constituency than conventional agriculture – the constituency from where new ideas come. Not all LINSA have an equal – or even significant - impact on change (4.2).

The conventional AKS plays a varying role in knowledge and innovation in LINSA. In some instances it is ill equipped to do so and in others there is a resistance on the part of LINSA to seek the support of the AKS (4.2).

Key elements in LINSA transition are: reflection on the status quo; action for new sustainable solutions, and dissemination of good practice. They should acknowledge the regimes and the localities in which they operate even though some may be less compatible than others. Transformation in this context should be both social and technical and these should be interdependent. Incremental innovation can be as successful as radical innovation as it is more likely to be adopted more widely at regime level (4.2).

TABLE OF CONTENTS

Introduction 7

1. LINSA as a special type of network in sustainable agriculture 9

1.1. Introduction **9**

1.2. Definition of LINSA **10**

1.3. Diversity and complexity of LINSA **10**

1.4. Development of LINSA **12**

1.5. LINSA – AKS relationship models **13**

1.6. Distinctiveness of LINSA **14**

LINSA as a special type of network - Summary **14**

2.1. Introduction **15**

2.2. Learning in LINSA **16**

2.3. Innovation in LINSA **20**

2.4. LINSA and sustainability **23**

2.5. Linkages between LINSA and learning, innovation, sustainability **25**

Learning, innovation and sustainability in LINSA - Summary **26**

3. Boundary objects and boundary work as analytical tools for examining learning and innovation processes in LINSA 27

3.1. Initial expectations of BOs and BW in SOLINSA conceptualisations **27**

3.2. SOLINSA analysis: revised conceptualisation of the role and traits of BOs and BW in learning and innovation for sustainability **27**

Boundary objects and boundary work as analytical tools - Summary **30**

4. LINSA and socio-technical change towards sustainable agriculture and rural development 31

4.1. Introduction **31**

4.2. SOLINSA analysis: innovations as multi-level transitions **32**

LINSA and socio-technical change – Summary **36**

References 37

Appendix 1 41

Introduction

The present report is a result of empirical work and theoretical analysis carried out by a consortium of eleven partner organizations within the project SOLINSA in 2011 – 2014, and as such it furthers the theoretical ideas outlined in SOLINSA WP2 Conceptual Framework (Brunori et al. 2011). The themes addressed in the present report sections mirror the original themes in the 2011 Framework. Each section starts with an introduction - a summary of initial theoretical thinking of the SOLINSA project and proceeds to present the new theoretical insights on meanings, linkages and models identified by researchers with regard to LINSA – Learning and Innovation Networks for Sustainable Agriculture, their contribution to transition to more sustainable agriculture and relationships with other innovation system actors.

The project studied empirically individual cases of 17 LINSA of varied origin, maturity, composition and objects of innovation, in eight EU countries. The list of the LINSA and their abbreviated names is provided in Appendix 1.

The main sources used in the report are various project deliverables - reports on specific LINSA traits, as well as specific WP summary reports (see www.solinsa.net and each section for the according reference). Another source is the research articles produced by project partners for the Special Issue of the Journal of Agricultural Education and Extension planned for January 2015. The synthesis of this material was led by the project partner 8 Baltic Studies Centre (BSC).

This Report on the Revised Conceptual Framework will be of interest to researchers addressing learning and innovation in agricultural networks, innovation as a socio-technical transition and the social construction of sustainability, as well as those interested in the more specific issues of methodology of multi-stakeholder network research and specifics of support activities for complex learning and innovation networks.

Figure 1 presents an overview of the initial ideas, reference theories and concepts and theoretical advancements of SOLINSA.

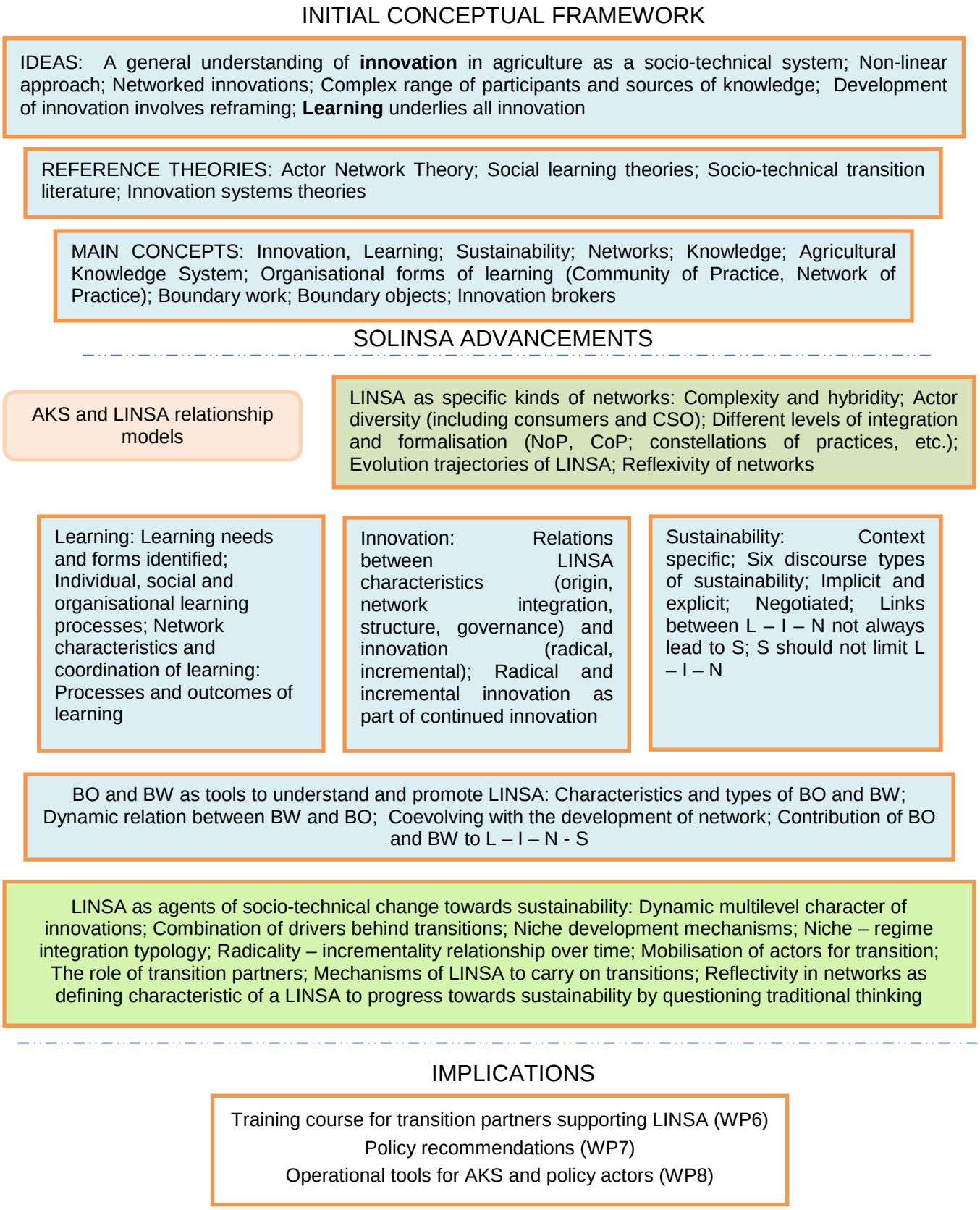

Figure 1. **SOLINSA conceptual advancement**

1. LINSA as a special type of network in sustainable agriculture

1.1. Introduction

The initial conceptual framework (Brunori et al. 2011) proposed a definition of LINSA: "LINSA are networks of producers, users, experts, CSOs, local administrations, formal AKS components, SMEs that create mutual engagement around sustainability goals in agriculture and rural development, and to this end they co-produce new knowledge by creating conditions for communication, sharing resources, cooperating on common initiatives." LINSA or Learning and Innovation Networks for Sustainable Agriculture were conceptualised as being places for innovation for sustainable agriculture; bottom-up initiatives that represent farmers' perspective and motivations to change, bottom up and alternative initiatives that progressively align in a more coherent assemblage, different projects and individual and collective initiatives. Based on the network form, they can bridge existing formal organizations and create hybrids that may develop through progressive institutionalization and formalization.

A review of abundant literature on innovation, networks, and learning for sustainability (e.g. Renting et al. 2008; Knickel et al. 2009; Bruckmeier and Tovey 2008; Wenger 2000; Klerkx, Aarts and Leeuwis 2010) allowed LINSA to be interpretad as (see Brunori et al. 2011):

1. Learning and innovation networks that: enlarge resource bases by establishing relations and coalitions between actors; accelerate processes of learning by enabling negotiation of meanings; have their own identity, values, norms and actual behaviour; might by hybrid involving people, organisations, non-humans, material and intangible objects that are used in learning and innovation activities (Latour 1987). When knowledge produced through social interaction is distributed among those participating in the interaction we can talk of social learning. Innovation occurs in networks (Powell and Grodal, 2005) and networks that connect individuals and organizations, can improve information diffusion, resource sharing andaccess to specialized assets (Powell and Grodal, 2005).
2. Organisational forms of social learning and innovation: communities of practice (CoPs) referred to a relatively stable communities of face-to-face interaction between members sharing a practice, mutual engagement, joint enterprise and shared repertoires (Wenger 2000, Amin and Roberts 2008); networks of practice (NoPs) of which CoP is a subset, that share a particular practice but may have weaker ties and do not necessarily share a common spatial boundary (Brown and Duguid 2001); constellation of practices (Wenger 1998) as broader organizations configured across different CoPs; webs of influencers on practice (Oreszczyn 2010) or an heterogeneous web of different kinds of actors, not just famers engaged in different roles and practices.

3. Alternative knowledge systems: LINSA may be strongly supported by the 'official' AKS; cooperation across institutional and cognitive boundaries may support effective reformism and integration between LINSA and their AKS. However, LINSA may exist outside of the 'official' AKS.
4. Drivers of socio-technical transition to sustainability: LINSA may range from networks that try to adapt to new regulatory requirements through incremental innovation, to networks that 'break the rules' of dominant socio-technical systems and build up new economic spaces endowed with their own rules, actors, and artefacts; in this case the LINSA focus is radical innovation

17 LINSA[1] were explored according to eight characteristics: origin and function, scale, network integration, level of innovation, level of learning, governance, links to AKS and efficiency and effectiveness of support (for details, see Ingram et al 2013 a). SOLINSA research advanced understanding of LINSA in several ways.

1.2. Definition of LINSA

The study reaffirmed the original definition of LINSA with some broadening with regard to actors involved. This updated definition was presented in a collective article in *EUROCHOICES*: "LINSA are defined as Learning and Innovation Networks for Sustainable Agriculture consist of producers, consumers, experts, NGOs, SMEs, local administrations and components of the formal AKS, that are mutually engaged with common goals for sustainable agriculture and rural development - cooperating, sharing resources and co-producing new knowledge by creating conditions for communication."(Brunori *et al* 2013). Thus the definition now involves also civil society actors and consumers.

In addition, a LINSA strongly focuses on the *process* of learning, i.e. negotiation and reflection among its members. Finally, this learning and innovation is targeted towards increasing sustainability, thus the practice of a LINSA is value-laden.

1.3. Diversity and complexity of LINSA

The SOLINSA study gave insights into the empirical diversity of LINSA and allowed the building of some typologies and groupings. **Different network typologies were identified**: from local scale to national or transnational; from small, simple homogenous networks to large, complex and diverse networks with multiple actors; from incremental to radical innovation; from top-down to bottom-up origin; and with action fields including non-food oriented, such as biogas production, food production oriented, such as dairy production, and consumer oriented, such as urban food networks (Ingram et al., 2013a).

By **innovation objectives three 'types' of LINSA were distinguished**:

[1] The list of individual LINSA is provided in Appendix A

- consumer oriented networks (e.g. direct marketing, urban food networks),
- non-food oriented networks (e.g. biomass, energy,) and
- purely agricultural networks or networks for sustainable land use (e.g. soil conservation, biodiversity).

The study developed further the notions of communities of practice, networks of practice, and complex learning and innovation networks. The original conceptualisation of LINSA as communities of practice was adapted to diverse and complex agricultural and rural development contexts in which individuals, groups, communities and organisations engage in learning and innovation towards sustainability on various territorial scales and in different organisational forms.

This allowed to identify **diverse constellations of LINSA**. The range of 'types' of LINSA vary form tight CoP (I CVR) to looser constellation of practices (L Fruit, E B&H). Some LINSA are formally bound organisations (G DLG, N Care). There are networks within networks, eg CoPs within wider network (F RAD, L Fruit) and CoP within NoP (H Nat, F Charter).

An example of a composite multilevel LINSA is the Network for Sustainable Agriculture (F RAD). F RAD consists of farmer groups. They hire experts and facilitators to manage these groups. There are 2 levels, each of them being a CoP: 29 local groups (about 70 farms and an adviser); and the whole network made of the 29 groups (3000 farmers and about 30 advisors). F RAD belongs to a larger network (FNCIVAM) which can itself be considered as a NoP: participants share practices, a vision, but the links among them are rather weak.

Different sort of networks were identified: with a **high degree of formality** (G DLG); with a **high degree homogeneity** (G Women); a loose network (N Dairy); a **'network of networks'** (E B&H). Participation of diverse agents is advantageous for diverse forms of learning and knowledge flows, leading to innovations. The actor diversity in LINSA enlarges the available knowledge pool, however, it might have also adverse effect if different actors pursue their individual interests and motivations within networks (L Biogas).

In terms of **structure**, some LINSA remain top down from the outset with strong personalities seeking to remain in control (EU organ). Others, structurally are open, with people joining and leaving the freely (H G7, E B&H). The **balance between diversity and commonality in LINSA is important** (e.g. L Fruit). In a poorly integrated network, knowledge is not shared because of competition concerns (L Biogas).

In terms of the structure and **degree of complexity**, three issues emerged across LINSA. The first is that most LINSA are **part of an overlaying organisational structure**. In other words, one LINSA can be overlapping with another LINSA or be a LINSA within a larger LINSA. In some cases individuals and organisations come into a LINSA bringing their own, often quite disparate, networks with them (HG7). The LINSA that see themselves as networks (for example L Fruit) are more open to this 'overlaying' and some positively promote it.

A second issue in relation to complexity and structure is the **degree of formality and informality** of the LINSA. Some LINSA are very formally constituted with 'legal' terms of reference (for example, G DLG) and others are completely informal, almost amorphous (EU organ). Some felt that a greater degree of formality in organisation, might help the LINSA to become more effective (HG7).

In terms of structures, too, organisationally, **LINSA mostly tend to have quite 'flat' organisational structures** with 'egalitarian', 'democratic' and 'open' management approaches.

1.4. Development of LINSA

Networks are not static but evolve over time, they may grow over time and depending on the radicality of the innovations they propose they may alter existing configurations of actors in current production systems and value chains (Knickel et al., 2009).

The study shows that LINSA may emerge from small groups of farmers (F RAD) or may be inspired by individuals (S Naturli, F RAD); can emerge as a formalisation of an existing diffuse network (E Perm); or grow by progressive process of co-opting local groups (F RAD). The structuring of the network often goes through a formalisation process (I Crisop). Policy developments (favourable opportunities to develop certain activities) and public attention to an issue (e.g. food quality concerns) might stimulate emergence of LINSA. Key individuals often initiate and drive the initial stages of network development

Over time networks develop because the participants have:

- A strong need for knowledge which can be obtained from each other (L Fruit);
- Economic benefits from membership (e.g. optimisation of activities and expenses) (N Dairy);
- A way to obtain official accreditation for activities (I CVR).

However, not all LINSA are keen to grow and become mainstream. Networks also may be quite vulnerable to external forces (new policies, economic challenges, etc.) over the course of their development.

Over time networks tend to formalise – develop rules, roles, procedures. Formalisation, improved organisational structures and professionalisation develop as a response to economic incentives, organisational failures and the desire for credibility. Different ways of formalisation exist – associations, integration into other existing structures, getting funded as a project.

Most LINSA tend to grow both in membership size, actor diversity and spatial coverage. The stages or phases of growth may follow the economic and market development (S Naturli, L Fruit), political opportunities (L Biogas), funding opportunities (F Charter), or societal demands (E B&H). There might be problems to accommodate new members and achieve mutual agreement when networks get bigger and involve participants of different backgrounds, like producers and consumers (I Crisop). When networks grow they seek legitimacy

through accreditation and standards (eg. N Care, E Perm, S Naturli) or research (N Dairy), or organisational consolidation as the growth the can no longer rely on trust (S Naturli).

1.5. LINSA – AKS relationship models

The SOLINSA study gained a more nuanced understanding of relations between LINSA and AKS.

The initial SOLINSA conceptual framework (Brunori et al 2011) proposed that LINSA relationship with the AKS is a powerful factor in LINSA development, depending on the way the LINSA and AKS were linked.

Overall, the SOLINSA study demonstrates that LINSA can either develop strong links to the AKS or remain outside it, establishing no connections, with gradations of closeness between these extremes. The relative closeness may have origins in funding dependency or historic ties, overlapping membership and some information sharing. A LINSA may have a relationship with a specific part of the AKS. Independence is however a strong value for LINSA, even when relationships with the AKS are perceived as good.

The SOLINSA study proposes that the nature of links between LINSA and AKS is related to the nature and level of innovation that the LINSA pursues. Thus, if innovation is too foreign to AKS competence and its established working practices, it is probable that it will remain in a marginal position with regard to LINSA, without active involvement. Therefore some LINSAs have "naturally" evolved outside AKS without its support. For instance, S Naturli, described as radical innovation of production and sale of milk and cheese, is developing almost entirely outside the traditional AKS.

Some LINSA choose deliberately to refuse establishing links with AKS as they „want to do things differently" and are exploring new practices „as a departure from existing agricultural systems and knowledge" (Ingram et al, , 2013b). On the other hand, there are many LINSA whose initiated changes have been well supported and advanced by AKS. For example, F Charter was created and is operated in close collaboration with AKS institutes; research institutes are well integrated in L Fruit LINSA where they play the important roles of knowledge creators and brokers; G DLG with its broad functions of farmers' education, advisory and research has become an integral part of German AKS.

Nevertheless, different value systems and ways of working between LINSA and AKS were commonly reported barriers in their cooperation however close it was (Ingram et al, 2013b). The openness of AKS institutes towards novelties both regarding their own working methods and sustainable agricultural and food chain development is a precondition for its effective participation in or cooperation with LINSA.

Thus the SOLINSA study demonstrates that the relationship between LINSA and AKS is a complex one, with both LINSA and AKS capable of initiating change or responding to it, however the outcomes largely depend on the degree of innovation and context factors. Yet, regardless of the ability or willingness to cooperate with AKS, LINSA may be an important driver of change in sustainable

agriculture, experimenting with new interpretations and practices and thus broadening the range of ideas available in the field.

1.6. Distinctiveness of LINSA

SOLINSA study provides some answers to the question of preconditions for a network to become a LINSA.

1. There has to be an integration between diversity and commonality; merely diversity of actors is not enough, they have to engage in common activities.
2. The general shared goal of innovation is also a discriminating factor in which actor belongs to LINSA and who is not a part of it.
3. Equal distribution of engagement (participation, commitment) is important in LINSA, although not all actors participate at equal extent.
4. A minimum level of governance and organization of network is necessary.
5. Reflexivity is an important characteristic of LINSA – network participants have to steward learning activities, reassess innovation objectives and evaluate sustainability performance.
6. Innovation and sustainability are to be connected and embodied in LINSA activities and practices of their members.

LINSA as a special type of network - Summary

LINSA are defined as Learning and Innovation Networks for Sustainable Agriculture. They consist of producers, consumers, experts, NGOs, SMEs, local administrations and components of the formal AKS, that are mutually engaged with common goals for sustainable agriculture and rural development - cooperating, sharing resources and co-producing new knowledge by creating conditions for communication.

Preconditions for a network to become a LINSA are: some commonality of views, shared innovation goals, the commitment of members, some level of governance and an embodied connection between innovation and sustainability.

LINSA vary in the degree of formality, modes of learning, size and degrees of consensus. LINSA grow for knowledge, economic and accreditation reasons. As they grow they tend to formalise but not all LINSA wish to become mainstream.

The study developed further the notions of communities of practice, networks of practice, and complex learning and innovation in agricultural and rural development contexts.

The nature of links between LINSA and AKS is related to the nature and level of innovation the LINSA pursues.

Distinct features of a LINSA are: integration between diversity and commonality; shared goal of innovation; equal distribution of engagement; minimum level of governance; reflexivity of members; innovation and sustainability embodied in LINSA activities

2. Learning, innovation and sustainability in LINSA

2.1. Introduction

Learning is in the very centre of SOLINSA conceptualisation (Brunori et al 2011), which stems from the idea that individuals and collectivities act on the basis of meanings they give to the information relevant to their practices. Agents broaden their **capacity to act** through evaluation and classification of new information, which then makes it knowledge. Acquiring information and processing is **learning**, thus there is a direct relationship between exposure to sources of new information, ways of processing it, and applying it (acting), in the case of SOLINSA, in a special kind of agricultural networks.

SOLINSA addressed **learning** in networks through two mutually reinforcing theoretical lenses.

Firstly, the lens of actor-network approach, which sees a network as a relational pattern through which resources flow. It is thus important to establish the micro-dynamics of network relationships: 1) connections between nodes, 2) extent of two-way communication, 3) belonging to multiple networks, 4) diversity of nodes and 5) adaptability of non-codified relationships between nodes.

The ability to negotiate diversity and achieve shared understanding depends on the **size and shape** of networks, as actors in a favourable relative position can form coalitions to increase their resources and create sub-networks, which then tend to lock-in into their practices. The ability to reach a degree of commonality also depends on the ability of actors to shift their norms and behaviour in response to constraints and opportunities in the **multiple** networks they belong to.

Overall, one of the key points for SOLINSA research was that in **learning in a network** there is a tension between the degrees of being **closed or open, and the dynamics between inside/outside of LINSA**. It impacts the range of learning, the extent of possible negotiation between divergent viewpoints, and the stability of achieved meanings, also poses the question of trade-offs, e.g. between diversity and stability.

To explore the dynamics of commonality vs. diversity in learning, SOLINSA used the second theoretical lens, that of social learning and communities of practice, which provides analytical tools to identify and examine the relevant learning practices.

To do that, the SOLINSA conceptual framework included the issues of mutual engagement, joint enterprise and shared repertoire, supplementing these concepts with boundary objects and boundary work (more on the latter in Section 4). Researchers were prepared to see variation in the degree of LINSA being closed or open. For instance, it was recognised that farmers might be appropriately described as a Network of Practice (NoP), as they are physically dispersed, they share practices but not often coordinate them; however they have shared identity and shared repertoires (Orescscyn 2010). However, learning in agricultural networks does not involve only farmers; they are part of a

much wider web of influencers on practice (ibid). Still another idea holds that the different types of actors involved in the network may not have a shared repertoire, but rather mutual engagement and joint enterprise – and considerable differences in norms, values and interests - which have to be negotiated (Klerkx et al 2010).

The SOLINSA conceptual framework distinguished between **individual**, **social**, and **organisational** learning, the core question being whether a considerable proportion of the learning is **social:** i.e., co-produced and distributed as a common good. The more socially distributed is the knowledge circulating in the network, the more there is potential for **innovation.** Thus it was noted that knowledge can be either part of the support resources of the network, or a part of power struggles (over knowledge), which is crucially important for the creation and dissemination of innovation.

Researchers assumed that in the interplay of the social and the economic concerns in learning, the ability to balance both would be essential for successful functioning of LINSA.

Thus it may be said that SOLINSA conceptual framework was to a considerable degree focussing on identifying the nature of the **processes of learning** in LINSA, linking these traits to possibility of creation, development and dissemination of **innovation.**

To sum up, in order to understand innovation, SOLINSA considered it critical to examine the considerable complexity of knowledge networks and information flows, relationships between agents inside and outside the network, between conventional AKS and farmers networks and take into account the factor of network development and its impacts.

With regard to characterizing innovation, SOLINSA used the concepts of incremental and radical innovation, stressing their dialectic relationship: first breaking the rules, then consolidating through small steps (Brunori et al 2011; p. 10). An important notion between another strict pair - top-down and bottom-up - is that of bricolage (Garud and Karnoe 2003), progressively aligning into something increasingly coherent.

SOLINSA conceptual framework is also more about exploring the “voluntaristic” dimension of networks, i.e. exploring the way agents shape and achieve their strategic goals and adapt to various partners (e.g. Gilsing et al 2007) in an ongoing negotiation process (e.g. Swan and Scarbrough 2005) with a heterogeneous set of actors, where AKS actors may not be dominant. This again makes it necessary to examine the balancing of openness and closeness, formality and informality, where outcomes may be either a lock-in of an innovation, or inability to mobilise support, or successful dissemination and new applications.

2.2. Learning in LINSA

In this section we characterize learning in LINSA, and examine the interrelation between LINSA characteristics and **learning** processes. We start with some general characteristics, then move to the relations between learning and network integration, and learning and network composition.

SOLINSA research demonstrates that learning is seen as a priority for most LINSA but the **focus** of learning varies. The WP4 Analytical Characteristics Report (Ingram et al. 2013a) points out that in the 17 LINSA studied, specific learning needs differ considerably and are highly individualistic; on the other hand, in many areas (management, administration, technical skills, etc.) the needs are shared.

As networks develop, learning **needs** change: learning requirements evolve according to new research, legislations, new social/consumer expectations and emerging technologies. Every learning process also involves difficulties, critical moments; especially when the network expands and its diversity increases, or innovation goals have to be adjusted. For example for I Crisop a difficulty emerged when new participants joined the network with their divergent agendas and views. In this case learning was successful. In another example, L Biogas network faced the challenge of public support being withdrawn and needed to learn how to respond to that in a collective, strategic way, but failed to do so.

Learning **forms** change, too. We may argue that each LINSA has a certain learning form repertoire: the combination of forms that work well for the LINSA. SOLINSA research demonstrates that a diverse repertoire **widens participants' opportunities** to access optimal knowledge sources, links individual and collective learning needs. For instance, as networks **develop**, changes in composition, formalization of relationships, possible expansion of either geographical scope and /or multiplication of goals may entail **an amplification of the learning repertoire**. For example, some LINSA in addition to formal training activities start to employ new-technology-based forms of learning (training videos, websites with Q & A sections). Other LINSA find considerable value in experiential, direct forms of learning (field days, study tours, learning circles).

With regard to individual, social and organisational learning, SOLINSA research demontrates the following (Ingram et al. 2013a):

- In most LINSAS learning at the individual level **predominates** and this develops from the knowledge needs of individuals who pursue these in different ways.
- **Social** or collective learning occurs within peer-to-peer groups during discussions and reflection (e.g. F RAD, I Crisop, L Fruit).
- Social learning **interacts** with individual learning for example in G DLG with every seminar/ study club farmers receive group feedback on their individual performance and farming practices and this contributes to their learning about their farming strategies and practices. Also in E Perm individual learning takes place experientially through practice, social learning through networking with other individuals is then used to share and validate this knowledge
- Some regard the acquisition of subject-specific information, particularly practical and technological information, as more of an individual exercise and interaction of members to negotiate the norms, roles and values of their LINSA as social learning (e.g L Biogas, E Perm).

- The scale of learning correlates with the **degree of formality,** individual learning takes place informally, group learning has a greater degree of *organisational* formality.
- Organisational learning is characterised as: inter-institutional learning and collaboration between researchers and practitioners (L Fruit) or demonstrated by the development of entities (e.g. the study farm 'Vecauce' in the L Biogas), and development history expressed as events, logo, common principles, rules and charters (e.g. G DLG, G Women, F Charter). Experiences from joint projects help larger LINSA member organisations to gain various forms of organisational learning although organisational learning is neither a declared goal and is often hard to identify (e.g. H G7). Organisational learning is planned and managed in some LINSA (e.g. E Perm).

Since the SOLINSA research examined networks that brought together a wide range of actors from various backgrounds, to understand the balancing of the **diversity** of motivations, perceptions, and expectations of these actors, to enable learning and development, was a key task. Overall, research demonstrated (Ingram et al, 2013 a) that participation of diverse agents is advantageous for diverse forms of learning and knowledge flows, leading to innovations. In the following sections we discuss some conclusions with regard to diversity and learning.

To understand the possibility of balancing diversity and commonality, we turn to the concept of community of practice and its analytical elements: negotiation of meaning, joint enterprise, mutual engagement, and shared repertoire. In terms of communities of practice, we note that LINSA indeed demonstrate a (broadly defined) joint enterprise, yet different degrees of mutual engagement between sub-groups of agents, and a range of learning repertoires, which may overlap to some extent but may also remain largely used by a specific sub-set of actors. Negotiation of meaning is the central process of balancing commonality and diversity, and SOLINSA research found that it may fail if there are too divergent interpretations of what the "joint enterprise" is and what appropriate ways to engage in it are. It appears that the shared interpretation of "joint enterprise" is central to LINSA. If it is in place, further negotiation of meaning (incl. learning) may happen.

(A useful concept to explain the alignment of divergent positions and broadening of support is "boundary work" and "boundary objects" - more on that in section 3.)

With regard to learning, we find that diverse needs and interests can be accommodated in two ways which predominate but do not function exclusively: careful coordination and formalization, or ad hoc and diverse learning mechanisms at work simultaneously. This is related to the network traits of **size and composition.**

Smaller and more homogeneous networks strongly promote mutual and peer-to-peer learning, but the pool of available knowledge might be limited. On the other hand, in complex networks more diverse knowledge is present. In complex

networks, the variety of knowledge flows and needs poses the issue of **coordination,** which is not always successfully resolved.

Coordination means a supportive learning infrastructure, coordinated and regular needs assessments and a certain degree of management. For instance, in L Biogas coordination of learning did not happen, since the network was too conflicting and there was insufficient network maintenance. Other examples are more successful. The I Crisop network purposefully invited trainers; the G Women organizes regular and systematic moderated meetings to address topical issues. F Charter has a structured multi-level learning and experience-exchange system which involves researchers, advisors, farmer group facilitators, and farmers.

SOLINSA research demonstrates **three types of coordination of learning and their relationship to the network traits** (Ingram et al, 2013b).

- LINSA with **uncoordinated** and informal approaches to learning are associated with diffuse networks, few links with AKS, and low priority given to learning.
- LINSA which are more developed tend to have **some formalised** learning concerning specific topics or using localised group activity, but overall coordination is limited. There is little formalisation of learning when: learning is implicit/tacit, learning is not a priority, networks are fragmented, large and diffuse, there are few links with AKS.
- LINSA with **a high level** of coordinated learning are associated with well-developed networks often linked to the AKS where expansion, accreditation, changing structures, possible extension of the brand and newcomers to the LINSA has necessitated a more coordinated and formalised approach.
- High level of coordinated and formalised learning is associated also with **accreditation** which brings the need for certain types of formal learning -administration and management skills, financial etc.
- Increasing formalisation or expansion can mean a shift towards more formalised learning which can **challenge informal learning**.

However, even when there is coordination for learning on certain issues, SOLINSA research (Ingram et al, 2013b) demonstrates that commonly, different mechanisms of learning **co-exist,** including peer to peer learning, transfer and dissemination, experience sharing, scientific seminars, etc. Actors seek out different kinds of knowledge in different ways: farmer-farmer for a specific technical problem on agriculture, while political-cultural-dissemination discussions occur mainly among the groups of non-farmers. In the L Fruit LINSA more specific and locally coordinated learning happens in sub-networks answering specific problems, while the learning in informal individual networks is more diffuse and mostly emerges from day-to-day interaction. Communication flow among the members is characterized by differing intensity, the degree of sharing among members differs in relation to the different subject areas of discussion (markets, technologies etc.) (e.g. I Crisop). Communication patterns develop over time and for some LINSA settle into stable patterns (e.g. I CVR).

An important issue in learning is **exclusion and inclusion** of certain groups of network participants. SOLINSA research indeed shows (Ingram et al. 2013a) that access to information and learning can be uneven, as some participants in networks may be more active and more connected so more able to access information (I Crisop). Sometimes only a core group of the most active participants are likely to be using many of the infrastructures and channels of communication and thus learning (e.g. L Biogas). The Internet as a means of communication is seen as providing equal access to all members, whereas communication mechanisms that require more effort and input such as projects, meetings etc, **preclude** some members due to required time, effort and expense. Some methods such as study clubs in N Dairy do not reach the mainstream of the farmers, it is estimated that currently they involve only 20%. This is related to issues of trust, as not all farmers want to disclose information about their private financial situation. In a similar vein, mistrust and an unwillingness to provide access about sensitive economic information is cited in other cases, e.g. L Biogas economic performance; EU organ. Cultural influences (e.g. H Nat) or unwillingness to share with "outsiders" (e.g. E B&H, E Perm) has also been noted as a barrier to knowledge sharing.

While some of the unevenness of access to learning is related to individual level of activity and initiative, in some cases there are evident or implicit "costs" to engagement in learning. On the other hand, there are also factors (lack of trust, sensitive economic information, cultural norms) that preclude network participants from sharing certain knowledge. This should be explored further, but can be argued to clearly relate to **network integration**, which in itself draws on network capabilities in negotiation of meaning.

Overall, in LINSA the researchers found that knowledge as a shared resource is indeed present, which confirms the potential of LINSA to integrate various knowledges and use them in a shared way, which can be conducive to development and innovation (to be explored in the next section).

We may note that SOLINSA research provides data on various approaches in balancing the degree to which the network is openor closed, knowledge shared or hoarded, which do not perhaps provide clear-cut answers, but rather alert researchers to considerable **complexity** of learning processes in LINSA. We can argue that in a successful LINSA there is a match between network traits, learning needs and approaches to learning.

The complexity of learning needs and knowledge flows, and co-existence of various forms of learning seems to support the view of **innovation** as an adaptable **bricolage** process, as SOLINSA research found that learning was seldom highly coordinated and directed. Neither was it uniformly inclusive or excluding, but rather happens as an adaptable process.

In the next sub-section we will comment some more on LINSA and innovation.

2.3. Innovation in LINSA

Several network traits have an impact on innovation in LINSA. We will address the impact of origin, key drivers, and degree of network integration on

innovation, and some dilemmas that LINSA have to resolve. (More detailed analysis of the degree of innovation and its trajectory is offered in section 4.)

Origin. The origins of the network may have an influence on the further trajectory of innovation and network development. For instance, L Biogas case demonstrates that politically initiated opportunity may attract to innovation too divergent stakeholders who share a learning need but not values. Failing to establish an integrated network affects the innovation development negatively. Thus we conclude that politically initiated opportunities for network formation do not necessarily mean the ability of the network to develop the innovation further.

Drivers. When bottom-up and top-down drivers converge, innovation has a better chance to succeed, e.g. in the case of Cooperative Boer en Zorg in the Netherlands (N Care), the government introduced system of health care (vouchers) fit well with the existing interests, labour and skill division and supply of involved care farms.

Some networks may be completely bottom-up, as for instance Brighton and Hove Food Partnership (E B&H) which is a civil society driven initiative, responding to broader societal demands of sustainable food systems, equity and well-being of citizens. The success of such innovation then depends on network ability to grow gradually and strategically build new civic partnerships.

Network integration. SOLINSA research demonstrates that innovation can benefit from quite tight network integration and management. Links between diverse actors (farmers, facilitators, advisors, researchers.) and purposeful network management and maintenance can enable the innovation to grow from novelty stage to a regime. That was the case of the Charter of Good Agricultural Practices in Livestock production, France (F Charter), which started as a project and grew into a network of 110 thousand farmers, 3000 advisors and involved also industry and retail chain actors with the goal of improving sustainability performance of livestock production. In a similar case of a composite multi-actor Fruit Growing Network, Latvia (L Fruit), innovation struggles to become a regime, since the network remains multi-focussed (production, consumer education, marketing, research) and network activities lack sufficient integration, and network maintenance is not as strong as in F Charter case.

Another important network integration aspect is the degree of being **open or closed** Some networks start as open, pro-active initiatives, with a strong innovation drive and vision, often inspired by network pioneers and leading personalities, and succeed to rapidly attract followers, establish a new practice, and thus implement innovation.

In the example of Natürli Co-operative Cheese production, Switzerland (S Natürli) the network skilfully manages the developed trademark and communicates with their stakeholders, having established a stable market niche for cheese producers. The network remains open to new participants and develops new kinds of products, relations with consumers, etc. A different kind of trajectory is demonstrated by I CVR, in which the network was initially open and involved technicians and researchers which helped to register PDO of a specific kind of cheese; as soon as this was achieved, the innovative practice

became routine of network participants, with no further willingness to innovate, and a closed membership.

We may suggest that **diversity** of stakeholders in the network is a critical factor in continuing to innovate. It is also an issue of the balance between the economic goals and new knowledge development goals, promoted by certain groups of actors. Networks may share different constellations of goals, and the willingness to innovate may be particularly related to the value of new knowledge creation (Amin and Roberts 1985). The presence of research and experimentation organizations and individuals in the network may keep it moving into new knowledge exploration even when the initial economic objectives are achieved, whereas if the network if predominantly constituted by conservative economic actors who strive to improve their practice predominantly for economic gains, the network may stop innovating once the original goals are achieved. Certain homogeneity and even conservatism is a cradle mostly for incremental innovation.

Strong network integration may be conducive to radical innovation, departing from the mainstream based on shared strong values and shared experiences. For example, Permaculture Community, England (E Perm) demonstrates a very strong commitment/engagement based on shared values of their members, values are a driver for innovation. I Crisop also united its members through shared value of organic agriculture.

Simultaneously, the close relations and strong degree of commonality of radical values may make the network vulnerable and weak in achieving innovation claims; innovation may remain small-scaled, on the level of novelty (E Perm). However, the homogeneous semi-closed network may survive through connecting to similar movements based on shared values and even spread geographically, acquiring traits of a **social movement,** involving supporters from other non-agricultural groups of society.

In general, while we do distinguish between **radical and incremental innovation**, it must be emphasised that a) they are context dependent; b) they are not always alternative to each other but may be considered as belonging to different phases of innovation: e.g. after the initial break with existing paradigms a lot of incremental innovation would follow. (More on that in section 4.)

A fundamental characteristic that connects networks and innovation is the dimension of **time.** SOLINSA research demonstrates the co-evolution of network and innovation: the framing of innovation and interaction changes over time. For example, in L Fruit, in the initial stages of innovation (integrated growing) the participants included farmers, peer communities and some researchers. Once the practice became more accepted, developed and acknowledged both by farmers and regulatory institutions, the network expanded, became more diverse, and embraced new aims (technical, social, consumer-oriented, public-health concerned, cultural etc.), and developed sub-communities.

SOLINSA research demonstrates that over time networks tend to become more formalized (they may become legal entities, enforce codified standards, establish internal governance rules and procedures, etc.). This may be a good

precondition to **disseminate** LINSA innovation and get recognition and protection in the political environment. Some less desirable consequences of this may be as follows: becoming a formal agricultural organization, de-coupling of innovation drive from the member collective, putting professional consultants, managers, trainers in charge of network maintenance; this may produce alienation and/or political struggle, and the network may lack skills to resolve these challenges.

Here again we find useful to refer to the concepts of boundary work and boundary objects (section 3), to outline the possibilities for aligning divergent positions of network participants.

2.4. LINSA and sustainability

A crucial element of any learning and innovation must be sustainability; SOLINSA views it as concept where it is particularly important to be reflexive and inclusive (Brunori et al 2011, p.5), considering the need to move away purely market rationales, integrate social concerns (ibid, p.6). There is a strong need to understand the different frames of stakeholders, as "sustainability" links different social worlds (ibid, p.31).

As noted before, SOLINSA research focused on networks whose learning and innovation is related to sustainability goals. Researchers started with the assumption that sustainability interpretation in each LINSA would be socially constructed and thus context-dependent and would contain diverse components.

Research demonstrated that it is indeed the case. SOLINSA case studies show that agricultural sustainability, the intended overarching goal of transitions driven by LINSAs, contains quite differing meanings for the involved actors (Hermans et al, 2013). This idea is not new as several authors (Pretty, 1998; Koutsouris, 2008; Hermans, 2009 etc) have already pointed to it. However, SOLINSA cases have been helpful to better understand how those meanings have evolved in specific **local contexts** and individual situations.

For instance, in S Naturli, sustainability has been developed around the idea of preserving local tradition of high quality cheese production and respective farming practices and life styles in remote mountain regions. The E B&H has emerged in environmentally active urban setting and it approaches agricultural sustainability with the lens of qualitative and accessible food. At its origin there was the need identified by local state to improve food at hospitals and integrate it in healing process. From here, E B&H had expanded the idea to use food and related initiatives and practices as a means to improve the sustainability of the city, its social equity, economic prosperity, environmental sustainability, fair trade and also the health.

Besides specific local contexts, changing landscapes – food, health, environment, energy, climate and other connected domains to agriculture and respective policies - shape external frames and bring in additional dynamics to sustainable agriculture initiatives. For instance, at the origin of F Charter there was a consumers' food scare after BSE crises; L Biogas LINSA reflects a growing global concern about the dependency on diminishing fossil fuel. So,

LINSA evolve in the interplay of individual, local and global factors and processes. They can be initiated in top-down or bottom-up or mixed-manner as coalitions of networks between rural actors and regime representatives, but as it will be described also further (section 4), most often those initiatives involve the interplay of all stakeholders.

As a consequence of the diversity of individual and context situations, the LINSA studied represent a broad diversity of a new range of actors, rules and artefacts which address different economic, social, technological, environmental components of the systems they operate in.

Some of the LINSA studied have taken a more holistic approach towards sustainability, for instance, I Crisop develops new economic, political, technical-organisational and cultural patterns; other cases are more selective and focused on separate sustainability elements. For example, N Care brings to forefront the social and economic aspects of sustainable agriculture, while L Biogas so far has been mainly concerned of economic and technological renovation of agriculture.

To analyse these differences in terms of social construction of sustainability, SOLINSA researchers identified **six different types of discourse on sustainability** in the 17 LINSA: Alternative Advocates, Sustainable Food Production, Autonomous Rural Development, Latvian Fruit, Care Farmers, Farmer Survival First (Hermans et al, 2013). The six different perspectives are united in their opposition to the utilitarian rurality discourse that emphasises competition on global markets, but they differ on issues like entrepreneurship, personal responsibility for sustainability, the role of the government, and technology as a potential solution.

From the six perspectives, the Alternative Advocates represent the widest range of LINSA respondents: there are respondents from 10 of the 12 investigated LINSA who subscribe to this view. This is also the perspective that is the most radical in its rejection of the productivist, technological discourse of mainstream agriculture. The perspectives of Care Farmers, Latvian Fruit growers and Autonomous Rural Developers offer slightly alternative sustainability perspectives that are based on a different emphasis of the importance of multifunctional countryside and the potential role of technology (ibid).

The perspective of the Sustainable Food Producers and the Farmer Survival First are more in line with the conventional agricultural mainstream in the sense that they still value the countryside for agricultural production and do not reject technological intensification of that production. Their sustainability perspective can be characterised by a focus on efficiently producing food and at the same time reducing the negative environmental pressures associated with that production (ibid).

It must be also emphasised that the idea of sustainability can be present implicitly or explicitly (in making decisions about adopting new practices or necessity of learning about them). SOLINSA research demonstrates that not all LINSA use the full vocabulary of sustainability when taking decisions with regard to their practices (yet the sustainability idea is implicit). Sustainability outcomes may be merely a by-product of adopting certain (innovative) practices stimulated

top-down. In other cases, e.g. E Perm, sustainability infuses all of LINSA practices and decisions.

Explicit presence of sustainability idea is demonstrated in examples of LINSA which include it in their codes of practice, learning agendas, etc. F Charter is an example of this approach. A variation on explicit presence is instrumental use of sustainability ideas, e.g. to maximize funding opportunities; make use of favourable government opportunities. Although it is a theoretical possibility, SOLINSA study did not encounter such examples.

Altogether SOLINSA cases confirm again that there are many pathways to sustainable agriculture as there are many understandings of what it means and diverse dynamic contexts in which they are embedded and take place.

2.5. Linkages between LINSA and learning, innovation, sustainability

As already noted, the richness/diversity of knowledge present in the LINSA networks and the social distribution of knowledge are important preconditions for innovation, thus forming a strong link.

SOLINSA research proceeded from the assumption that learning happens through negotiation of meaning, that is, knowledge is socially constructed. The same can be said about innovation, negotiating its value and the need to adopt, develop, or drop it. However of the three processes – negotiating useful knowledge, innovation, and sustainability, possibly the most intangible is sustainability. Its interpretation is influenced by ideologies, political statements, knowledge, definitions, but also regulations and discourses used in LINSA.

In its turn, sustainability is related to the interpretation of the value of innovation: the perceived presence or lack of contribution to sustainability is attributed to practices carried out by LINSA, and thus each instance of innovation can be described either as contributing to sustainability, or failing to do so.

Sustainability is also linked to learning. Interpretation of sustainability can evolve over time, start to include new dimensions, some of these promoted by broader societal concerns or special interest groups. On the whole networks operate in uncertain economic and political environments, with dynamic knowledge flows and new challenges. They have to adapt to ongoing sustainability debates and goals, that is, learn and improve their practices.

Importantly, the evolution and improvement of practices to meet higher sustainability goals may by itself stimulate new or disseminate existing innovation. Thus all three aspects become linked. A suitable example is F RAD, where farmers learn to gradually broaden the scope of their sustainable practices (which are incremental innovation), explicated in the Charter.

Another central linkage between learning, innovation and sustainability includes the need to filter and make sense of the available knowledge, especially technological, the bulk of which comes from industry and is not neutral, non-partisan. LINSA actors have to filter this knowledge skilfully.

There is also a need to regularly “unlearn” the out-dated, even harmful practices, critically access them, in the light of reaching innovation and

sustainability goals. LINSA have also to be able to deal with unsustainable outcomes of their own operation (including the application of innovative technologies, etc.), which in some cases may be unintended. These are additional important links between the three: learning, innovation and sustainability.

In all of these conceptual relations learning seems to be the most essential component, because no network, innovation or sustainability issue can be successfully addressed without learning/negotiation of meaning. If LINSA are to be effectively assisted, it **is precisely learning in the sense of facilitated reflection, alignment of meanings, and** spaces for interaction that should be supported.

However, it should be made clear that being socially constructed processes, learning and innovation do not necessarily lead to improved sustainability outcomes (since not all perspectives present in a network and successfully negotiated may have a good balance of public and private goals, for example). On the other hand, it is also not true that sustainability concerns should limit innovation, as SOLINSA empirical research demonstrates a broad range of innovation promoting sustainability.

Learning, innovation and sustainability in LINSA - Summary

Learning in a network means balancing a tension between the degrees of being closed or open, managing the relations of inside/outside, formality and informality. It impacts the range and outcomes of learning. SOLINSA found a number of linkages between learning, innovation and various LINSA characteristics. Learning is seen as a priority for most LINSA but the focus of learning varies. As networks develop, learning needs change. Organization of learning tends to follow three degrees of coordination. Different mechanisms of learning co-exist in LINSA.

Participation of diverse agents is advantageous for diverse forms of learning and knowledge flows, leading to innovations. Importantly, the study showed that knowledge as a shared resource is indeed present in LINSA, which confirms the potential of LINSA to integrate various knowledges and use them in a shared way, e.g. to innovate. After the initial success of innovation, continuing to innovate is an issue of the balance between the economic goals and new knowledge development goals, promoted by certain groups of actors.

Agricultural sustainability, the intended overarching goal of transitions driven by LINSA, contains quite differing meanings for the involved actors. SOLINSA cases have been helpful to better understand how those meanings have evolved in specific local contexts. There are six different types of discourse on sustainability in the 17 LINSA; they may be explicit or implicit.

No network, innovation or sustainability issue can be successfully addressed without negotiation of meaning; yet learning and innovation do not necessarily lead to improved sustainability outcomes. On the other hand, it is also not true that sustainability concerns should limit innovation, as SOLINSA empirical research demonstrates a broad range of innovation promoting sustainability.

3. Boundary objects and boundary work as analytical tools for examining learning and innovation processes in LINSA

3.1. Initial expectations of BOs and BW in SOLINSA conceptualisations

The Conceptual Framework interpreted learning as boundary process as it is linked to an outside/inside dynamic both at individual and at collective level and during which learning happens as absorbing existing knowledge from others and discovery or invention (Noteboom, 2006). So there is boundary work involved which makes the processes of transporting, translating and transforming knowledge between boundaries effective. The very boundaries, which can be cognitive, structural and geographical, represent 'spaces of intensified interaction' which mark differences and tensions, but also provoke and intensify interest, comparison, exchange and learning. The boundary notion was found productive for further research. Boundary work was separated from boundary interactions – events that provide connections but which can also become or be longer-lived.

Boundary objects were prescribed as organising elements of social learning. Using the reference to actor-network analysis (Star and Griesemar, 1989), the Conceptual Framework stated that in social learning settings mutual learning happens as negotiation over objects (material and immaterial) which connect different social worlds and different frames. Those boundary objects allow interpretative flexibility and therefore are negotiable, provoke also conflict and are constructed. Boundary objects take various forms: they can be artefacts, discourses or processes. Agricultural innovation is purposeful and deliberative creation of boundary objects and their importance is confirmed in a number of agricultural innovation studies (Schneider et al., 2009; Goldberger, 2008; Klerkx et al., 2010; Bos, 2009; Jakku and Thornburn, 2010).

3.2. SOLINSA analysis: revised conceptualisation of the role and traits of BOs and BW in learning and innovation for sustainability

This section represents an extended abstract of Tisenkopfs et al. (2015, forthcoming) – a paper submitted as part of a special issue on SOLINSA in the Journal of Agricultural Education and Extension.

The section of the revised Conceptual Framework below summarises knowledge extracted from SOLINSA case studies about the characteristics and types of BW and BOs in agricultural learning and innovation networks and notes their contribution in particular to learning, innovation and sustainability in agriculture and rural development.

SOLINSA case studies confirmed convincingly that multi-actor interactions and co-construction of meanings are central components in hybrid agricultural

learning and innovation networks, which means also that there is intensive boundary work implied. In particular, SOLINSA provided new insights into how actors cross boundaries with the help of various BOs to arrive at joint learning and innovations for sustainability. However, as expected, no comprehensive model was identified: LINSA employ a broad range of BOs and several kinds of BW, which correspond to the peculiarities of their specific contexts, the goal of innovation and the composition of involved actors.

SOLINSA case studies provided new evidence on the **multiple functions of boundary work** which helps to achieve various LINSA's goals, and demonstrate the **diversity of actors** involved in BW. The specific constellation of actors involved in boundary work is context-dependent. However, boundary interactions are not equally intensive among all LINSA participants. Often they are facilitated by leaders, influential personalities and actors with multiple structural positions. It was confirmed that also entire organisations can be drivers of boundary work in a LINSA. SOLINSA research developed a notion of **transition partners** in other contexts referred to as innovation brokers, innovation intermediaries, LINSA facilitators, etc. They are actively involved in BW and constructing of BO (see Helmle 2013 in Burkart 2013; Helmle et al. 2015, forthcoming).

To analyse BW, the SOLINSA study used Wenger's (2000) typology, distinguishing between **encounters** (visits, meetings, etc.), **practice** (joint work which gives opportunity for negotiation), and **specific work** (kinds of practice that result from special topics). Although LINSA apply diverse types of BW simultaneously, it was concluded that the predominant type of BW corresponds to the specific constellation of actors involved in the LINSA, the desired outcome and the BOs used. It must also be noted that boundary work is increasingly virtual**.**

Boundary work may develop spontaneously, but it can also be strategically targeted, with BOs selected to suit the interaction goals. The LINSA studied used a very **high number and diversity of BOs:** physically and conceptually varied objects. BOs are also different in being **general or specific** - this trait is much related to the stage of the network's development: a general BO is about 'ground rules' and is created in early stages of a network's life, while specific BOs are created to deal with more definite issues. Boundary objects are **embedded in the specific contexts** in which LINSA operate. Boundary objects are often **reified into artefacts**, which consolidate the negotiated shared knowledge, make it durable, and ease the dissemination of LINSA's knowledge beyond the network's boundaries.

Dynamic **interrelationships between boundary work and specific kinds of boundary objects** were established, differences based on LINSA goals and participating actor constellations. For instance, goals related to institutionalisation often show a pattern of *encounters and specific work* types of BW and use of *highly specific* BOs, often relying on scientific knowledge. Conversely, practice-based connections tend to prevail in learning activities and dissemination of incremental innovation. However, these interrelations need to be explored in further research.

Co-creation and smart use of boundary objects was identified as a strategy to improve effectiveness and efficiency of boundary work and by that the LINSA performance overall, by fostering interaction among participants and reducing the existing cognitive distances between them. In particular, SOLINSA elaborated on how BW and BOs facilitate learning, innovation and sustainability. Once created, BOs can be effectively used in LINSA external communication to promote LINSA ideas to consumers, policy makers and society at large.

BW and BOs for learning

For active and relevant learning to occur, the LINSA participants have to negotiate boundaries between 1) stakeholder groups representing **various knowledge bases** (e.g. practitioners and researchers), 2) **various attitudes** towards learning process and outcomes and 3) **various learning forms**.

Boundary work would include interactions to align participants' needs, expectations, perceptions and practices and allow new knowledge to be acquired. **BW co-evolves with the development of network** and there might be a hierarchy and/or sequence in BO produced during network development, corresponding to the changing LINSA knowledge needs. For example, in the initial phase of L Fruit development boundary objects progressed from appropriate apple varieties and cultivation techniques to marketing infrastructure, contracts with retailers, etc. Some LINSA demonstrate that **cultural activities and public events** (e.g. Cherry Days, food council meetings, etc.) can be a kind of aesthetically and socially meaningful boundary objects that connect LINSA with a wider public interested in sustainable development.

BW and BOs for innovation

Boundary work is instrumental also for the consolidation of innovation through network development and the creation of support for LINSA, namely for 1) **internal integration** of the network to make the more conservative participants to accept innovation, 2) **mobilisation of external supporters or users** of the innovation outside of the LINSA, 3) adjusting the network goals **to include new innovation goals**. The F Charter demonstrates how well-coordinated BW and establishing alliances with actors in power positions, notably AKS institutions, ensure the dissemination of innovation and making it a regime.

BW and BOs for sustainability

SOLINSA research confirms that negotiation of the meaning of sustainability is a complicated endeavour, due to the diversity of actors, their interests and the external messages from the general public and policy actors. Thus BW needs to **accommodate different attitudes and practices of sustainability** between 1) the LINSA participants and their groups, 2) LINSA and external civic groups, 3) LINSA and policy actors and/or the existing regime. Outcomes of BW are greatly influenced by the inclusiveness/exclusiveness of the vision, the presence of power imbalances, and diversity or homogeneity of actors. E B&H FP illustrates the dynamics and co-evolution of BW and BOs, from the initial general BO - a holistic vision of sustainable city development, to more specific ones – the City Food Strategy, supplemented by grants for urban gardening, etc. BW developed from encounters to specific work to practice-based

connections, all giving rise to implementing a transformative idea of sustainability, of a “breaking the mould” variety.

To sum up, BO and BW in LINSA have to provide space for actors to negotiate three processes and outcomes of the networks: learning, innovation, and sustainability. For each of them, BO and BW have to foster bridges in actor interpretations, attitudes and practices.

Altogether SOLINSA suggests a **careful consideration and planning of BW and application of BO**. Whether BOs emerge spontaneously or are created purposefully, strategic facilitation of boundary work ensures effective functioning of the LINSA and transition towards sustainability. Overall, two logics prevail. The first logic is singling out and developing a specific BO through targeted boundary interactions driven by active boundary spanning individuals/organisations. This may lead to fast learning and dissemination of novel practices, and stimulate dissemination of radical innovations through establishing prescriptive codes and methods. However, the impact of such BW may be limited to narrow groups of stakeholders. The second logic is involving a broader range of active actors and shared network resources so that BW is embedded in different network practices and there is a gradual, consecutive development of a range of BOs responding to network diversity and the scope of innovation. This kind of BW may produce a slower transition towards sustainability, yet the outcomes may be more durable.

Boundary objects and boundary work as analytical tools - Summary

SOLINSA research identified characteristics and types of BW and BOs in agricultural learning and innovation networks, as well as their contribution in particular to learning, innovation and sustainability in agriculture and rural development.

The study demonstrates how actors cross boundaries with the help of various BOs to arrive at joint learning and innovations for sustainability. However, no single model was found in performing BW and using BOs. LINSAs employ a broad range of BOs and several kinds of BW, which correspond to the peculiarities of their specific contexts, the goal of innovation and the composition of involved actors. BW is increasingly virtual. Dynamic **interrelationships between boundary work and the evolvement of boundary objects** were established.

BOs can develop either spontaneously or be strategically targeted to negotiate specific ideas. SOLINSA identified specific traits of BW and BOs in the domains of learning, innovation and negotiating the meaning of sustainability. **Smart use of boundary objects** is a strategy to improve effectiveness and efficiency of boundary work and thus LINSA performance overall.

SOLINSA developed the notion of **transition partners** which in other contexts are referred to as innovation brokers, innovation intermediaries, LINSA facilitators, etc. They are actively involved in BW and constructing of BO.

4. LINSA and socio-technical change towards sustainable agriculture and rural development

4.1. Introduction

For SOLINSA, the conceptual starting point with regard to innovation was an understanding that it is a relevant and beneficial change in the pattern of interaction between actors, rules and artefacts within a system. We also accepted that while some of the change appears from spontaneous responses to changing contexts, in many cases it is a consequence of more or less coordinated effort, which is not fully controllable, but adaptive and which is aimed at creating synergy and coherence among economic, social, technological, environmental components of a system, so called „effective reformism" (Roep et al, 2003; Klerkx et al, 2010).

To explore the drivers and barriers for this kind of intended innovation, we used the multi-level perspective of socio-technical transitions (Geels, 2004; Smith et al., 2005). This helps to see how actors can introduce enduring changes in rules and interactions at different levels of structuration of their life worlds and respective room for innovation, i.e, novelty, niche, regime and landscape. Innovation's transitions between those scales are subjected to various kinds of resistance and opportunities, and at each of them specific type of innovation (incremental or radical) is more or less likely to occur: radical solutions that challenge the dominating regime's rules are more likely to flourish at novelty and niche levels, comparatively separated bottom-up built micro-settings, while regimes are more open to incremental innovations. In order better to capture and address transitions to sustainable agriculture which may involve a broad range of innovations in terms of their radicality, SOLINSA concerned itself with innovation carried out predominantly by grassroots actors (although in different combinations of bottom-up and top-down initiatives), to reflect the realities of agricultural innovation, where regime actors (AKS) is only one of the components.

To explain the motivation for change and its realisation, i.e reorientation and locking out from old practices and transition to sustainable agriculture with considerations of public good, SOLINSA used the idea of framing. Specifically, this idea refers to dialectic relationship between individual and external frames. External frames as incentives and sanctions from institutions influence individual frames and the related behaviour, and the other way round – individual frames translated into (bottom-up) action have the ability of changing external frames.

SOLINSA thus related the pathways of innovation to reframing, and initially located the drivers for that in the following:

- Simultaneous belonging to different networks (which points to the interrelatedness of various elements driving reframing: financial incentives / sanctions, regulations, technical standards, social norms and ethical commitment, politics, feeling of stress / crisis);

- Desire to belong to a specific community (complying to a changed regulation/standard);
- Political and policy changes;
- Shocks (economic, social, natural);
- Social movements expressing broader societal concerns.

As an important part of the context of learning and innovation, SOLINSA examined the frames of different stakeholders present in LINSA and interaction of their frames.

4.2. SOLINSA analysis: innovations as multi-level transitions

SOLINSA empirical case studies have provided new insights into the transition towards sustainable agriculture and we expand on the reviewed conceptual framework here, in particular regarding:

- The dynamic, multi-level character of innovations
- The combination of drivers behind transitions towards sustainable agricultural practices,
- Niche development mechanisms,
- Niche and regime compatibility,
- Ambiguity of the divide between radical and incremental innovation.

Taking a critical approach of multi-level perspective, LINSA represent constituent niche projects which have been developing at the margin of the mainstream agricultural regime in a distinct value space (Ingram et al, , 2015 forthcoming), but which aim at broader regime- and landscape- level changes in the agro-food system, even if this is not always explicitly acknowledged by the LINSA itself. Some LINSA studied have succeeded in having an impact at regime level, others are still operating at novelty and niche levels, but each of them is witnessing the complex and dynamic multi-level and multi-dimensional process of sustainability transition where those various ordering levels interplay. These SOLINSA cases support the criticism of the static vision of the niche-regime-landscape, which instead can be seen as a dynamic, diverse and irregular interaction (ibid).

What are drivers for change: what are preconditions for a transition-initiative to emerge and develop? Transition, due to its complex character in comprehensively transforming life-worlds and their encompassing systems, is a very gradual process. It can be regarded as a flux into which LINSA represents a more structured setting among others. As LINSA show, there have been relevant events in that have led to their coming into being. The start of the transition is difficult to capture because we are dealing here only with the histories of LINSA as active components driving those transitions. There is a mixture of factors behind the emergence of LINSA and they are related both to regime opportunities or structural characteristics and individual initiative or active agency.

There are specific contextual events or processes which are provoking dissatisfaction or aspiration for change, and often they reveal shortcomings in the existing regimes. For instance, unification of food and loss of local breeds and specialties in the globalised food system was one challenging factors common in many LINSA (I CVR, L Fruit, S Naturli). Such tensions in the incumbent conventional agricultural regime create opportunities for the LINSA to provide new solutions and thus assist niche development (Ingram et al, 2015, forthcoming). In the meantime LINSA have emerged not only in spite of, but also because the existing regime and social structures have offered a room for that. The regime itself is changing as there is a growing pressure on the existing agricultural regime to become more sustainable, and it makes the introduction of further changes into the mainstream easier.

In recent decades sustainability has become an official leitmotif for many policies with various corresponding public support measures introduced. Although their efficiency in terms of promoting sustainability can be disputable (as, for example, in the case of L Biogas the existing official acknowledgement and support to sustainability has opened doors to many sustainable agriculture innovations which challenge the still dominant rules of productivism. Most LINSA have benefited in one way or another (funding, human resources, legitimacy, enabling policy) from public support; even the more radical ones. For instance, one activity leading to the establishment of the I Crisop was a Project about the valorization of organic farming which was financed from regional funds. Other LINSA have been introduced in a clear top-down manner. The L Biogas has developed as a niche only because of state support. This is true of individual LINSA to very varying degree, but LINSA actors cooperate with regime actors and draw on or contribute to different elements of the regime to help spread ideas and practices (Ingram et al, 2015, forthcoming). In the meantime, the existing regimes and established structures in agro-food systems prove to be still too restrictive for new patterns to allow their broad expansion. Some initiatives remain excluded, for instance E B&H "falls outside of the conventional agriculture system and is therefore not able to access funding through the CAP" (Ingram et al, 2013b).

In order to consolidate and upscale change, a broad mobilisation of actors is necessary. As shown in SOLINSA cases, next to farmers and policy makers, there are many other actors involved in shaping agricultural development. Especially consumers with their changing consumption habits and demands towards agriculture form a powerful group to initiate and carry on sustainable agricultural practices (as is witnessed in I Crisop, L Fruit, F Charter, N Care). Consumers may not be organised into social movements, cooperatives or associations, but still play important role as drivers of change by their daily food choices. Some LINSA studied (H G7, E B&H are explicitly aimed at raising consumers' food awareness. Also local and regional governments, due to their broad functions, resources and power, appear as key actors who can facilitate establishment of sustainable agricultural and food systems at local level. One prominent example how local governments engage in and benefit from LINSA are E B &H where the city council offers strong legitimate support for the LINSA as well as integrating the LINSA developed strategies in its official policies.

At the other extreme, there are actors who seem to be more resistant to change existing patterns and accept new ones. Many SOLINSA cases witness the absence or minor involvement of food retailers and processors. Sometimes it may be easier to establish new market actors (cooperative in S Naturli, farmers markets and cooperative in I Crisop) rather than "convert" existing ones, due to the ingrained situations in the existing regimes of the latter, but this needs further research as conventional market actors have remained outside the SOLINSA project's scope. But it is clear that the introduction of sustainable agriculture regimes and food systems cannot happen without devoted involvement of market actors.

Existing AKS institutions, which for many decades have supported "old" agricultural regimes, are involved in LINSAs and facilitate change through them to varying degrees. This is to some extent dependent on the level of innovation nurtured by the LINSA (see section 1 above). SOLINSA research data demonstrate that in most cases AKS institutions are not playing the leading role in driving socio-technical transitions, especially in those claiming for more radical and holistic changes in existing patterns, but they can propose valuable resources and knowledge to facilitate them.

From the outlined above, we can conclude that there are several mechanisms which assist LINSA, in carrying on transitions:

- Reflection on existing situations and developing a change of attitude: all LINSAs studied „share the commonality of coming into being as a result of a perceived need for change and an intention to improve the sustainability of food supply chains in some way" (Ingram et al, 2013b: ii).
- Action: new sustainable solutions, suitable to individual and contextual situations. LINSA show that sustainable solutions should take local circumstances and the optimal use of local resources into account
- Dissemination and coordination of practices at LINSA level (through common rules) and at a broader territorial level (some of the LINSA studied (E B&H HG7) represent such organised efforts at community / city level to coordinate and integrate various separate initiatives and thus add them additional influence). Coordination may also imply formalisation (certification, contracts, standards etc.), especially when LINSA are growing in their numbers and there is a need to reassure even quality in the network.

However, in order to make the organisational development mechanisms of LINSA efficient, relations and interlinkages with broader – regime contexts are as relevant as the level of LINSA and regime compatibility influences and the extent of LINSA diffusion (Ingram et al, 2015, forthcoming). Where the compatibility is high in terms of strong links and sufficient common ground for LINSA practices to link with the regime and be absorbed by the regime, comparatively rapid diffusion of innovation results. Conversely where the LINSA has very different values, visions, rules and practices from those in the incumbent regime the potential for linkage and for diffusion is low. Whatever the level of the compatibility between LINSA and regime, all LINSA however, should

build alliances and partnerships with regime actors that appear relevant for their consolidation and development. Extending networks and establishing effective networking between the LINSA and regime actors have proved to be helpful to facilitate diffusion and upscaling of innovation.

What is necessary for a transition to happen? As socio-technical transition and the SOLINSA case studies both show, both social and technical transformations are necessary for innovation and transition to happen. When this is not the case, innovations remain marginal or isolated as they offer poor technological solutions and/or cannot attract sufficient societal acceptance. Especially social elements of change – values, beliefs, patterns or behaviour and interactions etc. and their guiding frames, demand long time periods for change to come about, but it is impossible truly to introduce an innovation and make it durable without them. In L Biogas, a part of its actors have squeezed sustainable energy production into the old frame of productivism and profit. The old thinking, values and behaviour together with underdeveloped technical infrastructure (especially neglected systems for the use of the heat) and low societal support have endangered the sustainability of the innovation and restrained it from upscaling or being replicated. In turn, one of the success factors of the E B & H is that it is aiming explicitly at both targets: it seeks to implement „technical" projects of sustainable food initiatives and also develop new values and lifestyles.

Radical innovations have been associated with a better potential to induce radical changes in socio-technical systems. Although some peculiarities can be identified in the pathways of radical and incremental innovations, SOLINSA cases show that the degree of radicalness of innovation and its respective potential to bring on socio-technical transitions is not always evident and unequivocal. Radicalness or the incremental nature of innovation is context dependent. The same innovation can be incremental in one setting but quite radical in another. Probably what matters is the scope of changes it is able to induce during a specific time period. More radical innovations, especially bottom-up initiated, sometimes are not capable of fully realising their potential for change because of resistance in the system. Some SOLINSA cases which were described as more radical remain at local niche level (S Naturli).

As incremental innovations do not meet such resistance they are more likely to go beyond the novelty and niche scales and break effectively the existing rules in long term. For instance, F Charter includes consecutive minor improvements in farming practices which, precisely because of their moderate nature, are accepted by the vast majority of cattle farmers; and therefore the transition happens at the whole farming system level, reaching the level of regime. (However, transition in this case is also not smooth as tensions between more and less "radical" actors are emerging because of the compromises in which initial principles dilute. This means that also incrementally brought about transitions are charged with conflicts). More radical LINSA cases did not provide evidences on changes reaching regime level. (This also indicates the need for long-term and longitudinal innovation and socio-technical transition studies.)

Another point to make regarding radicality of innovation is that it is subject to transformations over time. Radical innovations have to survive in the contexts that they challenge. Therefore over time radical innovations may lose their

rebellious character and/or take such social, organisational and technological forms being adjusted to those that are acceptable for the dominant majority. For instance, E Perm is very radical as it challenges and changes the way we think about how food and resources are produced and used, but the LAND Project which was initiated as a permaculture demonstration network to the broader public is incremental in its nature as it does not challenge explicitly the dominant regime. Their radicality then is limited to specific well-marked spaces (demonstration sites in the case of permaculture), but still the innovation is reaching the goal of accessing the general public, which is one of the elements for achieving broader changes.

Socio-technical transitions aiming at fundamental and holistic changes in existing patterns are rather slow, multi-level and complex processes. Firstly, they demand transformations in actors' (be they farmers, policy makers, consumers, researchers, advisors, processors or other actors) cognitive structures, their frames and values which are rather resistant to rapid changes. Therefore not surprisingly, SOLINSA cases show that gradual incremental innovations reach transformations at regime level more easily as they face less resistance both from a social and a technical point of view. However, radical innovations, even if they remain local and scale up or diffuse more slowly, are important backbones for sustainability transitions as they demonstrate the feasibility of alternative life and working styles and serve as valuable sources of knowledge and inspiration.

LINSA and socio-technical change – Summary

SOLINSA research confirmed the dynamic, multi-level character of innovations in agriculture, and the existence of a combination of drivers behind transitions towards sustainable agricultural practices.

SOLINSA identified five types of niche and regime compatibility, and three mechanisms that assist LINSA in transitions: reflection, action, dissemination and cooperation.
The project results emphasize the ambiguity of the divide between radical and incremental innovation, as innovation may start as one and finish as the other, and vice versa.
SOLINSA cases also show that gradual incremental innovations reach transformations at regime level more easily as they face less resistance both from a social and a technical point of view. However, radical innovations, even if they remain local and scale up or diffuse more slowly, are valuable in that they demonstrate the feasibility of alternative life and working styles and serve as sources of knowledge and inspiration.

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Appendix 1

LINSA	Learning and Innovation Networks for Sustainable Agriculture
E B&H	Brighton and Hove Food Partnership, England
E Perm	Permaculture Community (Permaculture Association and the Land Project), England
EU organ	The European Organic Data network
F RAD	Réseau Agriculture Durable D) – Network for a Sustainable Agriculture, France
F Charter	Charter of Good Agricultural Practices in Livestock production, France
G Women	Bavarian Rural Women's Association, Germany
G DLG	German agricultural society, Germany
H G7	G7 (Local Food Council of Gödöllő), Hungary
H Nat	The NATURAMA Alliance, Hungary
I CVR	Consorzio Vacche Rosse, Italy
I Crisop	Association for Solidary Economy Crisoperla, Italy
L Biogas	Vecauce Biogas Production Network, Latvia
L Fruit	Fruit Growing Network, Latvia
N Care	Cooperative Boer en Zorg: Care Farmers in the Netherlands
N Dairy	Sustainable Dairy Farming, Netherlands
S ACDF	Association for the development of fodder production, Switzerland
S Naturli	Naturli Co-operative Cheese production, Switzerland
Other Abbreviations	
NoP	Network of Practice
CoP	Community of Practice