

Collective agency as a leverage point in multi-actor innovation: Two case studies from Swedish horticulture

Lisa Blix Germundsson¹ and Magnus Ljung²

¹Department of People and Society, Swedish University of Agricultural Sciences, Box 190, 234 22 Lomma, Sweden

²Department of People and Society, National Competence Centre for Advisory Services, Swedish University of Agricultural Sciences, Box 234, 532 31 Skara, Sweden

e-mail: lisa.germundsson@slu.se

The aim of this study is to investigate how horticultural firms meet their need for innovation within the innovation system. A comparative process ethnography approach was applied to two cases of long-term collaboration between multiple actors in Swedish horticulture. The retrospective reconstruction of the cases through documentation and interviews allowed for triangulation of data in a grounded theory approach. The leverage points of the developing collaborative processes were found to be; having agency and a network approach, the forming of collective agency through social learning, enhancing resource access, and operationalization of results. The concept of leverage points is useful for understanding evolutionary changes in multi-actor collaborations. The use of the concept of collective agency contributes to the understanding of the dynamics of demand articulation, illustrating a reciprocal process between the actors' individual agencies, and evolving over time through their social learning. The results point to a need for policymakers and practitioners to develop a broader understanding of how actors work in the innovation system to enhance knowledge development and innovation.

Key words: agricultural innovation systems, AKIS, demand articulation, collaboration, social learning, evolutionary perspective

Introduction

The agriculture and food sectors are facing multiple challenges in reaching their environmental and social sustainability goals, while at the same time ensuring viable food production and food security for all (UN 2015). To deal with these challenges, new policies from the European Union (EC 2020 a,b, 2021) emphasise the need to develop and strengthen knowledge exchange and innovation in the agri-food sector (EU SCAR AKIS 2019, OECD 2019). This paper investigates how small firms engage with other actors in knowledge development and innovation by employing two cases from the Swedish horticultural sector.

The consumption of fruit, vegetables, and berries has doubled over the last 20 years, with the value growth at the consumer level estimated at 5–10% annually in Sweden (Fernqvist and Göransson 2021, Lööv et al. 2015). The top priorities for modern consumers are convenience, health, and local and organic produce (Fernqvist and Göransson 2021). This offers the potential for Nordic horticultural firms, both pre-existing and new ventures, to increase their production. The Swedish horticultural sector is currently in a growth trend, with the total turnover at the farm gate reaching 6.6 billion SEK in 2020 (SBA 2021a) (Fig. 1).

At the same time, imports of fresh fruit and vegetables have increased rapidly (SBA 2016). Market competition puts high profitability pressure on horticultural firms, leading to fewer and larger firms through structural rationalizing. Since the peak of 5 296 Swedish horticultural firms in 1984, the decline rate has been nearly 100 firms per year, dropping to 1 818 firms in 2020 (SBA 2003, 2021b). The smallest firms, with less than 0.25 hectares of open field cultivation or less than 200 m² of greenhouse area, are not included in the official statistics (SBA 2021b).

From an international perspective, horticulture in Sweden has several disadvantages: the remote location, cool climate, high labour costs, high taxes and compliance costs, and complex environmental legislation (OECD 2018). This situation, in which horticultural firms compete for markets shares with imports from countries with fewer of these conditions, is shared by other Nordic countries. To survive market competition, horticultural firms need to innovate to meet customer and consumer demands, and ultimately, to stay in business.

Recent reports have revealed weak connections between Swedish academic research and the agricultural business sector, creating a fragmented innovation system, and a lack of alternative pathways to market (OECD 2018, Government Offices of Sweden 2015). Agri- and horticultural firms are facing deeper challenges than larger

companies in the agrifood sector when implementing innovation processes due to their limited internal resources of personnel, capital, skills and time (Johansson and Gidlund 2021, Bjerke and Johansson 2022). The horticultural industry mostly consists of many small firms, in comparison to the often larger market actors on which they depend for their sales (Ekelund Axelson et al. 2017). Hence, there is a need to develop and strengthen knowledge exchange and innovation in the horticultural sector. A similar need is reflected in the new agricultural policy for the European Union (EC 2021), where the member states are encouraged to improve knowledge flow and strengthen links between research and practice (ibid, EU SCAR AKIS 2019).

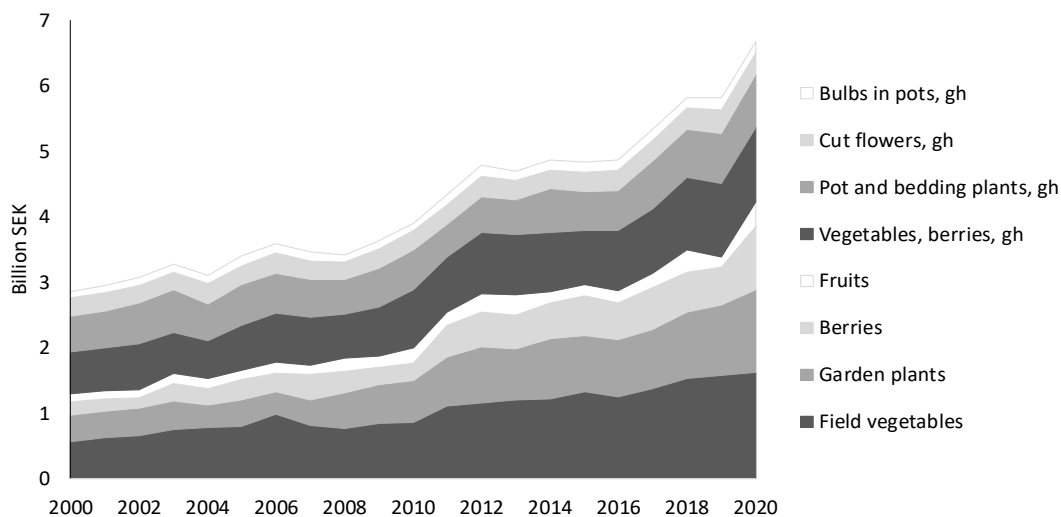


Fig. 1. Total turnover at the farm gate for horticultural products in Sweden between 2000 and 2020 in billion SEK (SBA 2021a). The abbreviation gh refers to greenhouse production. 1 SEK ≈ € 0.1

In summary, Swedish horticultural firms have several reasons to innovate. Yet, there are limited internal capacities for innovation, and weak connections between research and practice. How do horticultural firms develop new knowledge and innovation in order to promote their businesses sustainably and successfully? The aim of this study is to investigate how horticultural firms meet their need for innovation within the innovation system. The aim has been divided into two research questions:

How do horticultural firms access and make use of resources within the innovation system?

What makes some multi-actor collaborations become long-term?

To answer these questions, we investigate two long-term collaborations between multiple actors working towards innovation for sustainable business development in horticulture. To examine the cases, the theoretical perspectives of multi-actor collaboration and leverage points within innovation systems were used, as detailed below.

Theoretical framework

The literature on multi-actor collaboration within agriculture has developed as a response to the need for the joint input of farmers, advisors, researchers and other actors in knowledge development, environmental negotiation, and innovation (Blackmore 2010, Klerx et al. 2012). It builds on the assumption that new knowledge and innovation are best developed in interactive processes between various stakeholders, focusing on joint and social learning (Knickel et al. 2009, Moschitz et al. 2015). Farmers prefer to learn through interaction with other farmers and experts (Kilpatrick and Johns 2003, Šūmane et al. 2018). Guijt and Proost (2002) highlight the importance of experiential learning, monitoring and evaluation in providing quality input to social learning processes. As actors have different interests, they need to negotiate what to discuss, and how and when data should be collected (Guijt and Proost 2002). This implies that participatory monitoring and reflection are important parts of social learning processes. Reflection on observations is vital, as it opens opportunities for a change in underlying values and norms (Argyris and Schön 1995).

Actors can have diverging worldviews and still come together over specific issues or projects. In a diverse multi-actor setting, Daniels and Walker (2001) showed how progress regarding the subject matter took place when

the relational and procedural aspects between the actors had been adequately dealt with. This emphasises how mutual dialogue is a vital aspect of multi-actor collaboration. Such dialogue needs to contain social learning on four levels: about the subject matter, about the joint process, about the other actors, and about oneself (Kögler 1999). Isaacs (1999) notes that there is an immense power in quality dialogue and interactive deliberation between people (see also Waldenström 2001). A genuine dialogue creates something between people which cannot be created by any one party alone; it is “an art of not just talking together but of thinking together” (Isaacs 1999). While individual perspectives have limitations, meeting with others’ perspectives can create wider understanding and facilitate innovative ideas to emerge. This way of “thinking together” can develop when appropriately cultivated in a group over time, improving the group’s ability to solve problems and make use of opportunities (Isaacs 1999, Senge 2006).

An important driver of joint innovation processes identified in the literature is knowing what you want to achieve, or demand articulation (cf. Klerkx and Leeuwis 2008). This step requires an analysis of the already known and a will to push forward on a specific matter. Pelenc et al. (2015) call this *agency*, defining it as “the ability of a person to pursue goals and act in order to reach them in accordance with his/her values”. It refers to individuals and groups’ abilities to change their situation. Similarly, Giddens (1984) defines agency as an individual’s ability to “make a difference” in each situation, using one’s (temporary) power and influencing the powers of others. According to Pelenc et al. (2015), individual agency can go beyond narrow self-interest to encompass altruistic motives of a wider circle and contribute to the creation of collective agency. Such collective agency emerges in a social learning process, where this agency is shared with others; it cannot be imposed on anyone unwillingly (Pahl-Wostl 2006). Such a set of more or less shared ideas can act as a “specific resource for individual members in terms of orienting and coordinating their actions” (Pelenc et al. 2015). It facilitates and guides the members’ communication and decision-making and can lead to the adoption of joint goals for action. In this way, collective agency is a social structure, one which can contain social rules and mobilise resources (Giddens 1984). The concept of collective agency has been used in multi-actor approaches to environmental conflict (Pahl-Wostl 2006, Pelenc et al. 2015), and in social innovation promoting alternative food systems (Fernandez-Wulff 2019). Furthermore, the expression of demand articulation, which is closely connected to agency, has been found to be a dynamic process, unfolding with the learning processes of the involved actors (Kilelu et al. 2014).

Based on the work of Edquist (1997), an innovation system is defined as a network of entities for the furthering of innovations, and hence the innovation system is in this study defined as all actors involved in developing, communicating and using new knowledge and innovation in a broad sense, related to horticulture. It involves both public and private actors and includes the financial support needed for these activities (EU SCAR 2012). The innovation system can be seen as providing an enabling environment for processes of knowledge development and innovation (Klerkx et al. 2012). Such processes in turn have sub-processes of, for example, demand articulation, networking, and social learning, which can become leverage points for development and change (Leeuwis and van den Ban 2004). According to Senge (2006), the bottom line of systems thinking is finding leverage, as in finding the advantages that come out of identifying where small actions can lead to big improvements.

Leverage points are places to intervene in a system, where a slight change can alter a system towards a desired state (Meadows 1999, 2008). In a multi-actor collaboration context, leverage points can be linked to shifts in thinking and relating to each other. For example, there is always a potential to re-design interactions by changing the structure of information flows between stakeholders and their power to change or self-organise (EU SCAR 2012). In this way, new forms of interaction, implemented as small steps, can form the basis of significant change. Abson et al. (2017) criticise the practical use of leverage points in policy discourse, as this idea focuses too much on highly tangible, but essentially weak, leverage points, which may fail to result in transformative change. Meadows (1999, 2008) points out that while paradigm shifts are admittedly the most effective leverage points for changing systems, they are also the hardest to achieve. Lam et al. (2021) argue that the leverage point perspective can be applied as a conceptual framework to identify where local actors, engaged in multi-actor collaboration, can jointly and successfully intervene in a system.

Material and methods

Research approach and case selection

We have chosen a qualitative case study approach. The flexibility of qualitative research allows for the capture of the evolving and dynamic nature of social events over time, ideal for studying social processes and causality (Miles et al. 2020, Yin 2009). Following Leeuwis and van den Ban (2004), we have chosen a ‘comparative process

ethnography’ approach, meaning “the close following (or ex-post reconstruction) of events and interactions in and around a particular innovation trajectory, as well as the gathering of the participants’ reflections and rationalisations in connection with these”. Retrospective studies enable the recognition of overall patterns in innovation processes and aid the understanding of cause and effect (Leonard-Barton 1990). The idea behind the approach is to study the cases in such detail that a deep and multi-faceted understanding of the cases can be developed (Silverman 2005).

To identify relevant case studies, we conducted a search of the databases of four funders of applied research in agriculture and horticulture. The funding came from two national funds, a state fund for field trials and development projects, and a farmers’ levy fund for applied research (fund A and B); and two regional funds for university-industry collaborations in research and development projects (fund C and D). The database searches identified two cases of long-term collaboration which exceeded ten years, each involving a specific set of stakeholders comprising horticultural firms, advisors, and researchers. The two cases were identified through their subject area and the names of applicants. Early probes revealed that the two identified collaborations had produced both expected results and several spin-off projects investigating ideas that emerged from the processes over the years.

The topic of the first case was weed control in organic field vegetables, where the problem was the excessive costs of manual weeding. The approach included forming a participatory group of farmers, advisors, an advisory support expert, and researchers. Field trials were placed at and conducted by the four farmers. The second case dealt with the storing of fresh produce, where the problem was the lack of knowledge on storing and product quality for year-round provision to customers. A producer organisation and a university started a doctorate project, and evaluation and dialogues led to new ideas and further projects.

Data collection and analysis

Firstly, written sources concerning the two case studies were collected, including project reports, scientific papers, dissemination material and media articles. The purpose was to get background information on the two cases before the interviews.

Secondly, semi-structured interviews were conducted in 2019 with the individuals involved in the cases, as presented in Table 1. In case 1, one of the four farmers quit the project early, and one had retired and was unreachable; hence, only two farmers and a farm employee were interviewed. Two advisors participated in the project, with one also facilitating the discussions at the group meetings. The advisory support expert at the national authority had the role of providing advisors with new knowledge and further education, and in this case, was one of the initiators of the project. Two researchers with complementing expertise were involved in case 1.

Table 1. The interview respondents (n=14) and their roles in the respective cases

Case	Type of organisation	Representative
Case 1. Weed control in organic farming	Farms with horticultural production	Farmer 1
		Employee of Farmer 1
	Advisory services	Farmer 2
		Advisor 1
		Advisor 2, facilitator expert
	National agricultural authority	Advisory support expert
	University	Researcher 1
Researcher 2		
Case 2. Storing of fresh produce	Producer organisation	Former CEO
		Former advisor, current CEO
	University	Researcher 3
		Researcher 4
Related to both cases	Farmers’ organisation	CEO
		Expert

In case 2, both the former and current CEO and advisor of the producers' organisation were interviewed, as were two university researchers. The two representatives of a farmers' organisation were relevant due to their involvement in projects related to the two case studies, contributing a greater understanding of the context in which these cases emerged and existed. All interviews were audio-recorded and transcribed verbatim, except for four that could not be recorded for technical reasons, in these cases, detailed notes were taken. The average length of the interviews was 50 minutes.

As the case studies were viewed in retrospect, the research process has been a meticulous reconstruction of the cases through documentation and interviews. The interviews can be seen as reconstructing the long-term collaboration process by both the interviewees and researchers (Alvesson 2010). Using a grounded theory approach, we searched for patterns, as well as ambiguities and discrepancies, in the material (Charmaz 2006, Alvesson and Sköldbberg 2018). The documents and interviews complemented each other and offered a means of comparing and triangulating data. With the aim of unpacking the development of the case studies over time, the emerging results were visualised in timeline illustrations (Figs. 2 and 3). The use of such data displays (Miles et al. 2020) facilitated the data analysis and discussion between the authors.

Results

This section presents the two case studies of multi-actor innovation collaboration. First, a short background is provided, followed by interview excerpts illustrating the salient features of the cases.

Case 1. Weed control in organic farming

The first case started in the early 2000s, when advisory support experts at the Board of Agriculture heard from farmers that the cultivation of organic field vegetables had issues of high manual weeding costs. They presented the question to researchers whom they already knew. The researchers did a literature review identifying the biggest problems and a suitable model crop. Together they formed the idea of working closely with skilled farmers who were interested in experimenting with cultivation techniques, and contacted farmers who were thought to be interested in development work to improve weed control on their farms. All farmers had cultivations ranging from 40 to 80 hectares, including organic field vegetable production.

The plan was to have a participatory approach, with the trials conducted by the farmers on their farms. This put quite a high level of responsibility on the farmers at a busy time of the year. The farmers were thought to play an important role in providing their current knowledge and experience, and eventually in spreading the word about the findings to other farmers. A working group was formed of two researchers, four farmers, an advisor, an advisory support expert, the latter also being an experienced group facilitator. The project work started with a meeting of the working group to set up the plans for the first field season trials. The detailed plans for each farm were discussed individually. One of the researchers explains how this worked in practice:

"None of the trials was done without a joint understanding of what should be tested and how. We had one meeting a year, too few compared to usual participant-driven research, but there was always a discussion as we reported the previous year's results and planned the new season. However, the detailed plans I discussed individually with the farmers. And we decided that in one place it might be possible to rely on false seedbeds with delayed drilling, while someone else had a different idea. Often, the ideas came from the farmers, it was not unusual. And sometimes we came up with ideas from the research side, "maybe we could test this", but then [...] if they had good arguments, we had to back down. It felt good, in a way, to get this anchoring with the farmers. But when we thought we had a really good case, we argued for it and, in the end, they were interested; and then they also understood, and we got interest from their side to work with it." (Excerpt 1)

The quote reflects how the researchers saw themselves as co-working with the farmers. The farmers' knowledge and ideas were respected by the researchers as valuable contributions, and, since the farmers were conducting the field trials on their farms, it was important to ensure their understanding and support for the trials for them to perform the trials correctly and with care.

The researcher – farmer relationship was revealed to contain many dimensions. To start with, they had to learn to work together in ways neither of them had done before. One of the researchers reflects:

“In the beginning, you had to be out there and help a lot with starting the trials and discuss them. [...] But in the end, it was enough to call them and decide ‘this is how we want it’, then they would set up the trials, perform measures and send information to me when it was time for data collection. So that developed a lot, and it was because of their great interest in it.” (Excerpt 2)

The quote reflects how it was a lot more work in the beginning, with a need for negotiation and mutual learning to understand how the trials should be done and why. After a while, it was easier for all parties. This may reflect how both the farmers and the researchers learned how to do the work, both in terms of practicality and the ways in which they communicated with each other, and that the farmers’ interest in the results sparked engagement and care with the trials. One of the farmers reflects on the value they saw in the trials:

“I received some compensation every year for being part of the project, but the big gain was that we changed the way we grow our crops. [...] We are running this system exactly now.” (Excerpt 3)

The quote refers to the cultivation strategy with a specific timeline which was eventually developed within the project, building on the techniques of creating multiple false seedbeds, delayed drilling, harrowing and flaming the weeds.

The discussions during the trials, in the working group and bilaterally, generated further ideas. Some of the new ideas could be realised within the planned trials, but most of them needed additional funding as spin-off projects. Examples of such were new techniques for seedbed preparation, and the use and placement of starter fertiliser. The researchers wrote additional project proposals to several funders (Fig. 2). The many new ideas and added projects demonstrate the group’s emerging ability to maintain and develop collaboration. One of the researchers reflects on this:

“These ideas have come up in the project in different ways; they wouldn’t have come up otherwise, in the discussion with the farmers. The great thing about this is that if you work with a farmer and an advisor, and you see them all filled up with the joy of discovery, then it is difficult not to be caught by it yourself; and that made the project fun to work with.” (Excerpt 4)

In the excerpt, the researcher connects reflections on how the new ideas came about to their own motivation to work in the project. The researcher was influenced by the others’ joy of discovery, which spurred the motivation to continue. This may have contributed to the number of spin-off projects.

Between 2006 and 2014, the main study of weed control was funded by a 3-year project, granted 3 times, making a total of nine consecutive years. During the work with the main project, new ideas emerged as a result of trials and group discussions related to, for example, seedbed preparation and placement of fertiliser. The researchers were able to capture the emerging ideas into new project proposals and receive funding mainly from regional funders, resulting in a total of ten projects being performed. Further questions relating to the role of crop rotation for weed control were addressed in an additional six projects, with the trials for these held at trial sites (Fig. 2).

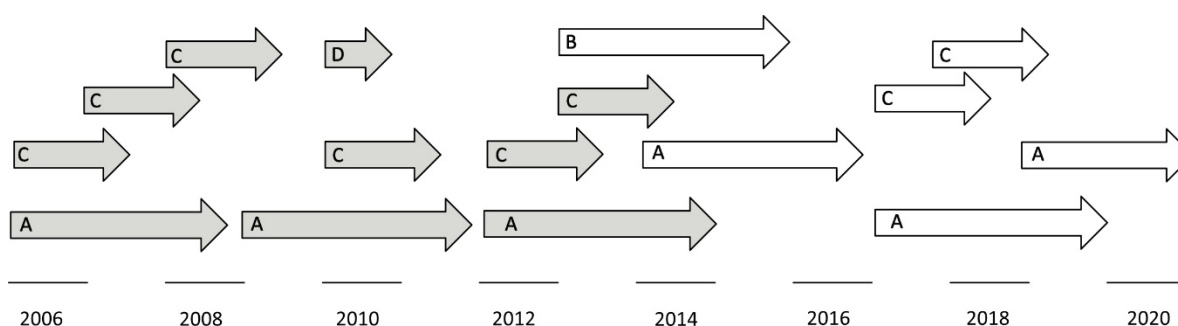


Fig. 2. Project funding in case 1. Case 1 was funded by ten projects between 2006 and 2014, illustrated by grey arrows. The A arrows mark the funding of the main project, and the B-D arrows mark additional funding for spin-off ideas. The letters A-D correspond to the funders mentioned in the material and methods section. The white arrows illustrate the six projects dealing with follow-up questions.

Case 2. Storing of fresh produce

The second case has its roots in the 1990's, when the import restrictions on fresh produce were lifted and domestic fresh produce faced new price competition from imported goods. The former CEO of a producer organisation of around 100 farmers, started his job at around this time. He describes how the most important issue was to increase the price of their fresh produce in order for the growers to survive. The earlier import restrictions during the domestic season meant insufficient focus on the quality of the domestic produce. When the restrictions were lifted, the grocery chains asked why they should pay more for domestic than imported when it was of such poor quality. This reflects the starting point for many years of work focused on improving product quality and storing of the domestic produce.

Soon after, some of the producer organisation's warehouse facilities needed to be replaced. In connection with the warehouse construction, the former CEO contacted the university research station because of the need to understand how storage of the domestic varieties should be carried out. After a dialogue between the producer organisation and the university, a doctorate project was started in 1999, with the aim of investigating pre- and post-harvest factors influencing storability.

Around the time the doctorate study was finished, the researcher and a newly appointed advisor at the producer organisation sat down together to turn the research findings into a practical booklet on optimal harvesting periods, reflected in the following quote from the advisor:

“My first project was when [the researcher] and I got together. The doctoral thesis is about that, ripening and storage ... So, the first thing I sat down and did with [the researcher] was to make a booklet ... And this is what we still use for our growers, it is the result of the dissertation. We tried to show how we can illustrate [the findings], how we can systematize them. Then, I've been working with it ever since. It's the basis of everything we do here.” (Excerpt 5)

The booklet was an easy-to-understand and practically applicable systematization of the dissertation aimed at farmers, estimating harvest readiness. Training activities were arranged for farmers to aid the adoption of the new knowledge into new routines.

The doctorate project had pinpointed several areas which the producer organisation and university researchers wanted to investigate further. Together with another researcher, they started a small project around reducing storage losses. In a continuous dialogue between the producer organisation and the researchers, collaborative projects were planned and carried out, with the support of funding bodies (Fig. 3), as discussed by one of the researchers:

“We have had a series of projects with [funders] where one follows the other. It is not unusual to start a little wider, with a number of threads, and then see which ones are worth continuing with. It has been a logical sequence, where you still want to get to practical application.” (Excerpt 6)

The quote above reflects how the threads of this case were a continuous dialogue between the actors, where projects ideas were tested and evaluated along the way. This made the dialogue important, as reflected by one of the representatives of the producer organisation in the quote below:

“Often it has worked like, I have just said that I have an idea, then [the researcher] has looked it up in the literature, then told me what they found, and then we have discussed based on that. [...] We have had long-term, close relationships and easy contact paths. [...] [The researcher] can be called at any time and you never feel stupid, [the other researcher] is the same.” (Excerpt 7)

Key to this quote is the statement of “long-term, close relationships and easy contact paths”, reflecting the appreciation of the quality of the dialogue with, in this case, the researchers.

In most years, a meeting was held in the winter, where the results were presented and the plans for the next season were discussed, along with emerging ideas and issues. The researchers presented the results and the producer organisations and others contributed with their practical expertise. This reflects the role of the winter meetings for evaluating results and raising new ideas and questions between the actors.

From 1999 to 2018, eleven projects were performed relating to the storing of fresh produce (Fig. 3). The early projects led to several others, as new ideas emerged in the process, such as those related to pre- and postharvest treatments. The related further questions were dealt with in a new doctorate project from another funder.

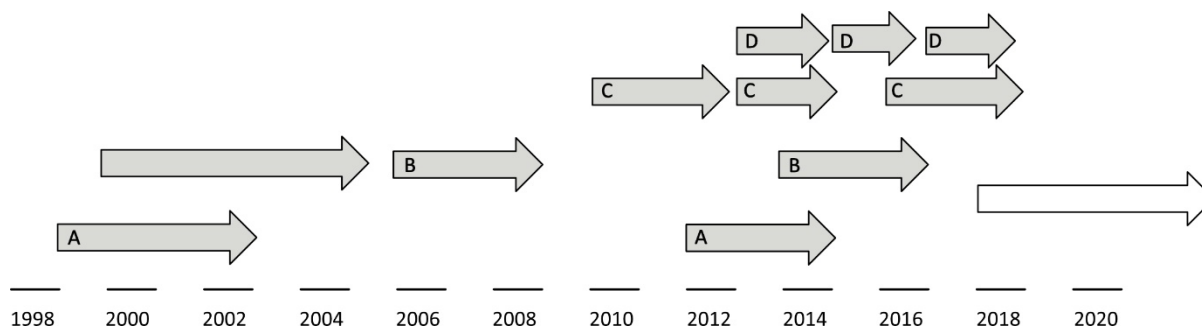


Fig. 3. Project funding in case 2. Case 2 was funded by eleven projects from 1999 to 2018. Letters A-D correspond to the funders mentioned in the material and methods section. The white arrow illustrates further funding to continue the research. The arrows with no letters denote projects received from other funders.

Discussion

How do horticultural firms access and make use of resources within the innovation system?

The start of the two cases reflects a similar pattern: firstly, someone recognised a problem and decided to act on it (e.g., the advisory support experts saw the high cost of manual weeding, and the producer organisation needed to improve product quality and storing). This is understood as agency, meaning an active force dealing with a perceived problem or opportunity (Giddens 1984, Pelenc et al. 2015). Secondly, these individuals decided that their problems could best be dealt with in cooperation with others; they contacted researchers they knew themselves or through others. This signifies a network approach, viewing collaboration with others as the preferred path to move forward. By inviting others to join forces in dealing with the problem, a collective agency was created around solving the issue, a social structure guiding the communication and decision-making of the involved individuals (Pelenc et al. 2015). This happened through dialogue and a social learning process, leading to the formation of concrete ideas about project set-up and funding. The forming of collective agency enabled the horticultural firms to draw on the strengths of researchers and advisors with complementary skills, thus forming the basis for developing the collaboration and for accessing the resources of the involved actors.

The concept of collective agency has hitherto mainly been used to denote social innovation in a larger public setting (Pahl-Wostl 2006, Pelenc et al. 2015, Fernandez-Wulff 2019). This paper, however, illustrates how the concept can be used in the context of a distinctly limited group of individuals of heterogeneous backgrounds and knowledge traditions. Their collective agency was developed for solving specific questions relevant to certain groups of individuals, in this case within horticultural production. The use of the concept of collective agency as a social structure formed by social learning underlines the evolutionary perspective of collaboration and illustrates how emerging social structures can be used and built upon in the further collaboration.

While in both cases new actors such as researchers were invited to share the original agency, over time, the sharing of agency went both ways. For example, the need for a joint understanding of the trials was emphasised by the researcher in order to settle on a trial plan agreed upon by all parties and ensure the job was done properly (Excerpt 1). Hence, the farmers would share the researchers' agency in a collective agency based around the trial plans. This illustrates how the collective agency of the group is reciprocal. The collective agency evolves over time, as the joint learning process re-shapes the agency of the actors. This is a further elaboration on the notion of dynamic demand articulation by Kilelu al. (2014), by illustrating how it is a reciprocal process between the actors' individual agencies and how it evolves over time through their social learning.

The fact that the agency originated from the practical needs of the horticultural firms, may have contributed to the motivation and long-term interest in finding solutions. The actors found each other through pre-existing

networks; intermediary organisations were not involved at the start. As horticulture is a relatively limited industry in Sweden, this may have contributed to the actors finding each other.

The ability to find funding enabled horticultural firms to access resources within the innovation system. In both case studies, the researchers were successful in finding funding for the main projects as well as numerous spin-off projects from a variety of sources (Figs. 2 and 3). This enabled continuous dialogue and contributed to the groups' abilities to maintain and develop their cooperation over several years. It is a skill in itself to identify funders, adapt project ideas and write proposals that are likely to be accepted. As reflected in Excerpt 6, the funding provided resources to test emerging ideas, and to deepen the learning dialogue between the parties around the issues. The many short projects in Figures 2 and 3 reflect the fragmentation of the funding within the innovation system. More importantly, they show the commitment and work done by the researchers, which illustrates the strong collective agency that emerged.

Thus, having a strong agency, a network approach, and an ability to form collective agency, paired with an ability to obtain funding, were ways for the horticultural firms to access and make use of resources within the innovation system.

What makes some multi-actor collaborations become long-term?

The feedback from the trials provided input for experiential learning in the groups and contributed to a higher quality of social learning (Guijt and Proost 2002), which in turn enabled new thoughts and ideas. For example, Excerpts 4 and 7 illustrate the way actors express how new ideas were born in cooperation with others. In the dialogue, new methods of seeing things were elaborated, starting with someone voicing an idea, allowing others to comment and contribute with their views. The different views of others on the phenomenon adds new perspectives and knowledge to the original idea (Isaacs 1999).

The respondents made references to the relationship with others, suggesting this was an important trait of how new ideas were introduced. The comments about 'the great thing' of working with farmers and advisors who are 'filled with the joy of discovery', and the pointing out of 'the long-term, close relationships and easy contact paths', reflect a sincere appreciation of their relationships (Excerpts 4 and 7). This emphasises the importance of the relational aspect being in place for progress to be made (Daniels and Walker 2001) by illustrating how the quality of the relation influences the social learning and generation of new ideas. It relates to the "thinking together" concept (Isaacs 1999) by illustrating the importance of good professional relationships for the generation of new ideas in a multi-actor setting. Excerpts 4 and 7 also reflect the significance of evolutionary changes in the relationships between the actors, as they illustrate how they can allow for deepened relationships where new dimensions are uncovered.

Furthermore, the results illustrate the various levels of learning necessary in collaboration projects (Daniels and Walker 2001) (Excerpt 1 and 2). In case 1, the actors discussed their collaborative process at the yearly winter meetings. The bilateral dialogues around the details of the field trials meant that they had to learn to understand each other's views of the trial set-up, the practical work, and how to negotiate this. The dialogue that formed the basis for decisions on the trial set-up required the actors to get to know the perspectives and motivations of other members, also illustrating the evolving character of their relationships over time. This is in line with the findings of how farmers prefer to learn through interaction with other farmers and experts (Kilpatrick and Johns 2003, Šūmane et al. 2018), and illustrates how the learning goes both ways, when advisors and researchers learn from horticultural firms. The findings also relate to Kögler's (1999) notion of how the dialogue includes learning about oneself; it contributes to the understanding of how collaborative processes may lead to change for the involved individuals themselves, as they gain new insights about themselves through others.

Finally, the results illustrate how the findings from field trials and experiments were operationalized into the commercial activities of the farmers and producer organisation, which in turn led to new ideas. This contributed to the longevity of the two collaborations, as the new ideas needed to be tested and evaluated. This adds a long-term dimension to the findings of Guijt and Proost (2002), reflecting how the evolutionary changes in the relationships between the actors allows for deepened understanding of the others' interests and stakes involved in the testing, monitoring and reflection on the results. The operationalization of the results meant that the resources used for the projects were turned into tangible changes in the practices of the firms, thereby contributing to their sustainable business development (Excerpt 3 and 5).

In summary, the ability to develop “thinking together” by evolving their relationships over time, to continuously find funding for testing new ideas, and operationalization of results, contributed to the groups’ abilities to maintain and develop their cooperation over several years.

Reflections on the results

The results of the two cases illustrate how collaborative processes and social structures developed over time. The two cases originated in having agency and a network approach, which through dialogue and social learning led to the forming of collective agency. This, in turn, enabled access to resources in terms of competence and project funding for field trials and experiments. The subsequent findings prompted operationalization of results, which contributed to new insights. This led to renewed agency for the involved individuals, which were subject to further deliberation and social learning within the groups, and further evolved their collective agency. This illustrates how each step taken created conditions for the next step, here illustrated as a circle, which led to an emerging ability to maintain and develop the collaboration and knowledge generation (Fig. 4).

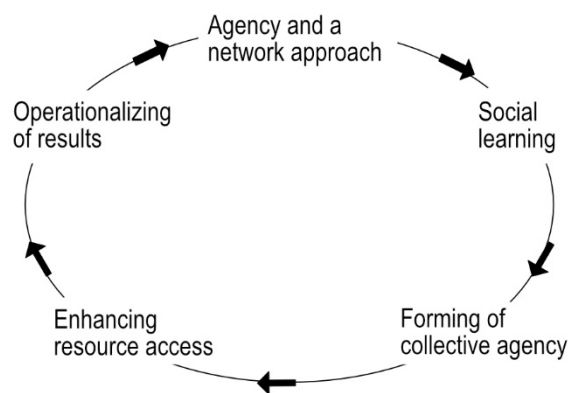


Fig. 4. The leverage points of the collaborations

Building on what Meadows (1999, 2008) and Senge (2006) label leverage points, points at which small interventions have the potential to bring about transformative change, we propose that a composition of small leverage points can provide deep potential impacts. The identified leverage points played a critical role in transforming the processes of the two cases, as they became the starting point for doing things differently together. It was the smaller but qualitatively important differences in how things were done together that altered behaviour, trajectories, and outcomes, which in turn enabled greater change. Hence, we propose a view of leverage points as many small steps, rather than one specific action behind a desired development. In this way, the use of the concept of leverage points in a multi-actor setting contributes to the understanding of evolutionary changes in multi-actor collaborations.

Conclusions

With the aim of investigating how horticultural firms meet their needs for innovation within the innovation system, the following conclusions have been reached.

The results of this study suggest that a composition of small but qualitatively important changes at specific points can provide deep potential impacts; the difference in how things were done, altered behaviour and trajectories, in turn enabling greater change. Having agency and a network approach, and an ability to form collective agency, paired with an ability to obtain funding, were ways for the horticultural firms to access and make use of resources within the innovation system. The ability to develop their “thinking together” by evolving their relationships over time and to continuously find funding for testing new ideas contributed to the groups’ abilities to maintain and develop their cooperation over several years. The feedback from the trials and experiments and operationalizing of results contributed to a higher quality of social learning and the generation of new ideas.

The use of the concept of collective agency as a social structure formed by social learning underlines the evolutionary perspective of collaboration, and illustrates how emerging social structures can be used and built upon in the further collaboration. It also contributes to a deeper understanding of the dynamics of demand articulation, illustrating it as a reciprocal process between the actors' individual agencies, and evolving over time through their social learning.

The use of the concept of leverage points contributes to the understanding of the evolutionary developments of multi-actor collaborations. It illustrates how the group processes and relationships evolve over time, marked by the leverage points. It is in these identified leverage points where increased awareness and targeted efforts could achieve the greatest results in supporting knowledge development and innovation in horticultural firms. The findings also illustrate the significance of evolutionary changes in the relationships between the actors and contribute to the understanding of how collaborative processes may lead to change of the involved individuals themselves.

The implications for practice include that horticultural firms and other actors, by being aware of these leverage points, can make use of them to strengthen their own work of developing new knowledge and innovation according to their needs. The findings underline how the developing and maintaining of networks is a worthwhile pursuit for horticultural firms, even when time and resources may be scarce.

For policymakers, the results point to a need to develop a broader view of how actors work in the innovation system, to include the identified leverage points. The results suggest that funding is needed for services including addressing agency, providing network facilitation, finding complementary skills, guidance of social learning processes to form the basis of collective agency, and enhancing resources access and operationalization through seed funding and project funding.

The study was limited by the fact that the two case studies had their own specific interplay and co-evolution of contextual factors and emerging processes. Further examples of locating leverage points in complex systems of multi-actor collaborations in future research may provide a deeper and broader understanding. However, we propose that the leverage points found in this study, together with further examples, can provide a contribution to the development of a broader understanding of how actors work in the innovation system to enhance knowledge development and innovation.

Acknowledgments

This research was funded by Sparbanken Skåne/Sparbanksstiftelsen, SLU Partnership Alnarp, SLU RådNu, and the Royal Swedish Agricultural Academy – thank you all. We extend our sincere gratitude to the respondents for sharing their views and insights. We would also like to thank the anonymous reviewers for very helpful comments.

References

- Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C.D., Jager, N.W. & Lang, D.J. 2017. Leverage points for sustainability transformation. *Ambio* 46: 30–39. <https://doi.org/10.1007/s13280-016-0800-y>
- Alvesson, M. 2010. *Interpreting Interviews*. London: Sage. 162 p. <https://doi.org/10.4135/9781446268353>
- Alvesson, M. & Sköldbäck, K. 2018. *Reflexive Methodology. New vistas for qualitative research*. 3rd ed. London: Sage. 437 p.
- Argyris, C. & Schön, D.A. 1995. *Organizational learning II: theory, method and practice*. Addison-Wesley series on organization development. 305 p.
- Bjerke, L. & Johansson, S. 2022. Innovation in agriculture: An analysis of Swedish agricultural and non-agricultural firms. *Food policy* 109: 102269. <https://doi.org/10.1016/j.foodpol.2022.102269>
- Blackmore, C. 2010. *Social Learning Systems and Communities of Practice*. London: Springer. 225 p. <https://doi.org/10.1007/978-1-84996-133-2>
- Charmaz, K. 2006. *Constructing grounded theory*. London: Sage. 388 p. <https://doi.org/10.1002/9781405165518.wbeosg070>
- Daniels, S.E. & Walker, G.B. 2001. *Working through environmental conflict. The collaborative learning approach*. Westport, Praeger Publishers. 301 p.
- Edquist, C. 1997. *Systems of Innovation; Technology, Institutions and Organizations*. London: Pinter. 431 p.
- Ekelund Axelson, L., Hansson, T., Johnson, L., Kristofferson, A., Lundqvist, S., Malmström, F., Nilsson, U., Persson, B., Persson, M., Sandin, H. & Spendrup, S. 2017. *Branschbeskrivning Trädgård (in Swedish)*. Alnarp, Swedish University of Agricultural Sciences, LTV-faculty. 106 p.

- EC 2020a. A European Green Deal. Striving to be the first climate neutral continent. Brussels, European Union. 24 p.
- EC 2020b. Farm to fork strategy. For a fair, healthy and environmentally-friendly food system. Brussels, European Union. 23 p.
- EC 2021. Regulation EU 2021/2115. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R2115&from=EN>. Accessed 1 March 2023. 186 p.
- EU SCAR. 2012. Agricultural knowledge and innovation systems in transition - a reflection paper. Brussels, European Commission. 121 p.
- EU SCAR AKIS. 2019. Preparing for future AKIS in Europe. Brussels, European Commission. 373 p.
- Fernandez-Wulff, P. 2019. Collective agency in the making: How social innovations in the food system practice democracy beyond consumption. *Politics and Governance* 7: 81–93. <https://doi.org/10.17645/pag.v7i4.2111>
- Fernqvist, F. & Göransson, C. 2021. Future and recent developments in the retail vegetable category - a value chain and food systems approach. *The International Food and Agribusiness Management Review* 24: 27–49. <https://doi.org/10.22434/IFAMR2019.0176>
- Giddens, A. 1984. *The constitution of society: outline of the theory of structuration*. Cambridge: Polity Press. 402 p.
- Government Offices of Sweden 2015. *Attraktiv, innovativ och hållbar - strategi för en konkurrenskraftig jordbruks- och trädgårdsnäring* (in Swedish). Swedish Government Official Reports, SOU 2015:15. Stockholm: Ministry of Enterprise and Innovation. 185 p.
- Guijt, I. & Proost, J. 2002. Monitoring for social learning. In: Leeuwis, C. & Pyburn, R. (eds.). *Wheelbarrows full of frogs. Social learning in rural resource management*. Assen: Koninklijke Van Gorcum. p. 215–231.
- Isaacs, W. 1999. *Dialogue and the art of thinking together: a pioneering approach to communicating in business and in life*. New York: Currency. 428 p.
- Johansson, S. & Gidlund, M. 2022. *Innovation i livsmedelskedjan, slutrapport* (in Swedish). Sweden Food Arena. <https://sweden-foodarena.se/kunskapsrapporter/>. 56 p.
- Kilelu, C. W., Klerkx, L. & Leeuwis, C. 2014. How Dynamics of Learning are Linked to Innovation Support Services: Insights from a Smallholder Commercialization Project in Kenya. *The Journal of Agricultural Education and Extension* 20: 213–232. <https://doi.org/10.1080/1389224X.2013.823876>
- Kilpatrick, S. & Johns, S. 2003. How farmers learn: Different approaches to change. *The Journal of Agricultural Education and Extension* 9: 151–164. <https://doi.org/10.1080/13892240385300231>
- Klerkx, L. & Leeuwis, C. 2008. Matching demand and supply in the agricultural knowledge infrastructure: Experiences with innovation intermediaries. *Food Policy* 33: 260–276. <https://doi.org/10.1016/j.foodpol.2007.10.001>
- Klerkx, L., van Mierlo, B. & Leeuwis, C. 2012. Evolution of systems approaches to agricultural innovation: concepts, analysis and interventions. In: Darnhofer, I., Gibbon, D. & Dedieu, B. (eds.). *Farming Systems Research into the 21st Century: The New Dynamic*. Dordrecht: Springer Netherlands. p. 457–483. https://doi.org/10.1007/978-94-007-4503-2_20
- Knickel, K., Brunori, G., Rand, S. & Proost, J. 2009. Towards a Better Conceptual Framework for Innovation Processes in Agriculture and Rural Development: From Linear Models to Systemic Approaches. *Journal of Agricultural Education and Extension* 15: 131–146. <https://doi.org/10.1080/13892240902909064>
- Kögler, H.H. 1999. *The Power of Dialogue. Critical Hermeneutics after Gadamer and Foucault*. Cambridge, MA, USA: MIT Press. 322 p.
- Lam, D.P.M., Martín-López, B., Horcea-Milcu, A.I. & Lang, D.J. 2021. A leverage points perspective on social networks to understand sustainability transformations: evidence from Southern Transylvania. *Sustainability Science* 16: 809–826. <https://doi.org/10.1007/s11625-020-00881-z>
- Leeuwis, C. & van den Ban, A. 2004. *Communication for Rural Innovation. Rethinking agricultural extension*. 3rd ed. Blackwell Science. 412 p. <https://doi.org/10.1002/9780470995235>
- Leonard-Barton, D. 1990. A Dual Methodology for Case Studies: Synergistic Use of a Longitudinal Single Site with Replicated Multiple Sites. *Organization Science* 1: 248–266. <https://doi.org/10.1287/orsc.1.3.248>
- Lööv, H., Widell, L.M. & Sköld, O. 2015. *Livsmedelskonsumtionen i siffror - Hur har konsumtionen utvecklats de senaste femtio åren och varför?* (in Swedish). Jönköping: Swedish Board of Agriculture/ Jordbruksverket. 84 p.
- Meadows, D. 1999. *Leverage Points. Places to Intervene in a System*. Hartland, USA: Sustainability Institute. 19 p.
- Meadows, D. 2008. *Thinking in systems. A primer*. Chelsea: Green Publishing. 218 p.
- Miles, M.B., Huberman, A.M. & Saldana, J. 2020. *Qualitative data analysis, a methods sourcebook*. London: Sage. 381 p.
- Moschitz, H., Roep, D., Brunori, G. & Tisenkopfs, T. 2015. Learning and Innovation Networks for Sustainable Agriculture: Processes of Co-evolution, Joint Reflection and Facilitation. *The Journal of Agricultural Education and Extension* 21: 1–11. <https://doi.org/10.1080/1389224X.2014.991111>
- OECD 2018. *Innovation, Agricultural Productivity and Sustainability in Sweden*. OECD Food and Agricultural Reviews. Paris, OECD Publishing. 190 p.
- OECD 2019. *Innovation, Productivity and Sustainability in Food and Agriculture: Main Findings from Country Reviews and Policy Lessons*. OECD Food and Agricultural Reviews. Paris: OECD Publishing. 186 p.
- Pahl-Wostl, C. 2006. The Importance of Social Learning in Restoring the Multifunctionality of Rivers and Floodplains. *Ecology and Society* 11: 10. <https://doi.org/10.5751/ES-01542-110110>
- Pelenc, J., Bazile, D. & Ceruti, C. 2015. Collective capability and collective agency for sustainability: A case study. *Ecological Economics* 118: 226–239. <https://doi.org/10.1016/j.ecolecon.2015.07.001>
- SBA 2003. *The 2003 Horticultural Census, concerning 2002*. Statistiska meddelanden. JO33SM0301. 75 p.

SBA 2016. Marknadsöversikt 2016, frukt och grönsaker (in Swedish). Report 2016:22. 88 p.

SBA 2021a. Statistikdatabasen. Sveriges officiella statistik (in Swedish). <https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/>. Accessed 22 February 2023.

SBA 2021b. The 2020 Horticultural Census. Statistiska meddelanden. JO 0102. 11 p.

Senge, P.M. 2006. The fifth discipline. The art and practice of the learning organisation. 2nd ed. New York: Crown Business. 445 p.

Silverman, D. 2015. Interpreting qualitative data. London: Sage. 489 p.

Šūmane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., Rios, I.D.I., Rivera, M., Chebach, T. & Ashkenazy, A. 2018. Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture. *Journal of Rural Studies* 59: 232–241. <https://doi.org/10.1016/j.jrurstud.2017.01.020>

United Nations 2015. Resolution adopted by the General Assembly on 25 September 2015. Transforming Our World: The 2030 Agenda for Sustainable Development. https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf. Accessed 15 December 2022. 35 p.

Waldenström, C. 2011. Constructing the world in dialogue: a study of advisory situations in Swedish agriculture. Doctoral dissertation, Department of Education, Stockholm University. 217 p.

Yin, R.K. 2009. Case study research: design and methods. London: Sage. 219 p.