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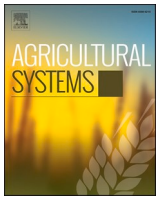

Exploring how social capital and learning are related to the resilience of Dutch arable farmers

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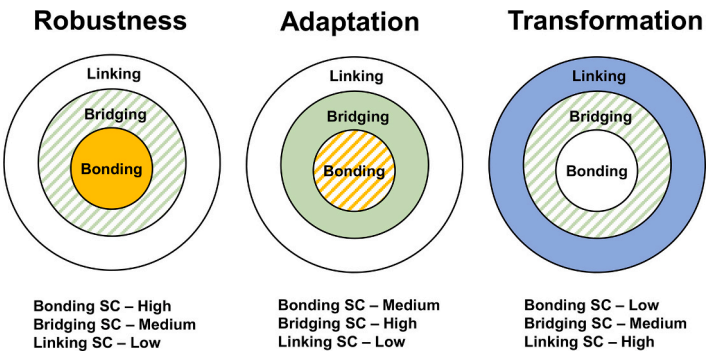
HIGHLIGHTS

- We explore how social capital and learning are related to farm resilience.
- We study the robustness, adaptability, and transformability of arable farms using a qualitative and quantitative methods.
- Social capital helps farmers to learn, enabling them to obtain more complete information and potentially enhance resilience.
- Different combinations of bonding, bridging, and linking social capital relate to robustness, adaptation, and transformation.

GRAPHICAL ABSTRACT



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ABSTRACT

CONTEXT: Enhancing farm resilience has become a key policy objective of the EU's Common Agricultural Policy (CAP) to help farmers deal with numerous interrelated economic, environmental, social, and institutional shocks and stresses. A central theme in resilience thinking is the role of the unknown, implying that knowledge is incomplete and that change, uncertainty, and surprise are inevitable. Important strategies to enhance resilience are exploiting social capital and learning as these contribute to improved knowledge to prepare farmers for change.

OBJECTIVE: This paper explores how social capital and learning relate to farm resilience along the dimensions of robustness, adaptation, and transformation.

METHODS: We study the resilience of Dutch arable farmers from the Veenkoloniën and Oldambt using a combination of four methods. Qualitative data from semi-structured farmer interviews, focus groups, and expert interviews are combined with quantitative data from farmer surveys. The qualitative data are analysed using thematic coding. Non-parametric tests are used to analyse the quantitative data. Based on methodological triangulation, we mostly find convergence in our qualitative and quantitative datasets increasing the validity of our findings.

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RESULTS AND CONCLUSIONS: The results reveal that social capital and learning help farmers to adapt and are, in certain cases, also related to robustness and transformations. Robust farmers often learned by exploiting farmers' informal social networks, primarily relying on bonding social capital to acquire knowledge about agriculture or develop financial skills. Farmers undertaking adaptation are characterised by bonding and bridging social capital obtained by formal and informal networks, are early adopters of innovation, and have high self-efficacy. Combinations of bridging and linking social capital from formal networks could foster farmers to learn new ideas and critically reflect on current farm business models. These learning outcomes relate to farm transformations.

SIGNIFICANCE: This study provides some early results on the dynamic relationship between farmers' social capital and learning and how these concepts are associated with resilience. Our findings are relevant for agricultural policy makers, as we provide recommendations on how social capital and learning have some potential to facilitate farm adaptation and transformation and improve information exchange in Agricultural Knowledge and Innovation Systems (AKIS).

1. Introduction

In an unpredictable world where farmers face numerous economic, environmental, institutional, and social shocks and stresses, enhancing resilience has become a key policy objective of the EU's Common Agricultural Policy (European Commission, 2020). Resilience theory recognises the role of the unknown in the complex and dynamic farm operating environment (Cabell and Oelofse, 2012; Darnhofer, 2014), implying that knowledge is incomplete and that change, uncertainty, and surprise are inevitable. Farmers, therefore, need various anticipating, coping, and responding strategies to deal with shocks and stresses across economic, environmental, and social dimensions (Mathijs and Wauters, 2020). Developing these strategies requires learning and social capital, as these contribute to improving knowledge and preparing farmers for change, uncertainty, and surprise (Cundill et al., 2015).

Several studies conceptualise resilience based on indicators to capture the multi-dimensional character of resilience (Resilience Alliance, 2010; Cabell and Oelofse, 2012; Biggs et al., 2015) or gain an understanding of resilience by studying dynamics using adaptive cycles (Holling, 1973; Carpenter et al., 2001; Gunderson and Holling, 2002). Recent developments in resilience thinking have acknowledged the importance of three complementary resilience capacities—i.e. robustness, adaptability, and transformability (Folke, 2016). Our understanding of farm resilience builds on these developments. We define farm resilience as a farm's ability to provide functions (i.e. public and private goods) while facing shocks and stresses through the resilience capacities of robustness, adaptability, and transformability (Meuwissen et al., 2019). While robustness relates to stability and the maintenance of current production practices, adaptation and transformation require the ability to change and to be flexible (Folke, 2016). Adaptation is reflected by changes in a farm's input and output composition as a response to shocks and stresses (Meuwissen et al., 2019). Transformation involves more radical changes in the farm structure (Darnhofer, 2014), potentially involving the delivery of alternative functions. Transformations can be the result of either the accumulation of incremental adaptation or a radical change leading to considerable redistributions of the primary production factors (land, labour, capital) or outputs (Vermeulen et al., 2018). The required mix of the three complementary resilience capacities is context-dependent.

The aim of this paper is to explore how social capital and learning are related to farm resilience along the dimensions of robustness, adaptation, and transformation. More specifically, this paper investigates how social capital allows knowledge to be exchanged through networks, which could foster farmers' ability to learn (Dolinska and d'Aquino, 2016) and potentially enhance resilience (Barnes et al., 2017; Barnes et al., 2020).

We understand learning as a combination of both social learning—i.e. learning in a group through social interactions (Reed et al., 2010)—and individual learning. A large array of conceptual studies have addressed how learning can be embedded in a resilience framework, including how social capital enables social learning through networks (Kilpatrick et al., 1999; Tregear and Cooper, 2016), transformative learning (Tarnoczi, 2011; Pahl-Wostl et al., 2013), normative, cognitive, and relational learning (Huitema et al., 2010; Baird et al., 2014), and single, double, and triple-loop learning (Pahl-Wostl et al., 2013; Cundill et al., 2015). This resulted in several empirical studies that have investigated how learning contributes to resilience or to one of the resilience capacities. For instance, Glover (2012) found that learning from both successes and failures strengthened the resilience of English farms by increasing the ability to deal with adverse events. However, most of the existing studies focus on how learning enhances farm adaptation. These studies provide useful insights into how learning enhances farm adaptation by improving the ability to deal with uncertainty, dynamics, and complexity (Darnhofer, 2010; Milestad et al., 2010), increasing knowledge about challenges (Darnhofer, 2010), improving reflexivity (Pelling et al., 2008), or stimulating experimentation (Tarnoczi, 2011). Recently, other scholars explored the role of learning in facilitating transformations. These studies demonstrated how radically changing perceptions, preferences, values, and norms may facilitate transformations (Scholz and Methner, 2020).

Most of these studies did not consider how learning relates to resilience along the dimensions of robustness, adaptation, and transformation simultaneously. It is important to consider all three resilience capacities to fully understand how farmers cope with and respond to shocks and stresses. To do so, we build on the conceptual framework of De Kraker (2017), which emphasises the current learning setting, learning processes, and learning outcomes to provide a more systematic view of how learning contributes to resilience. The contribution of this paper is exploratory, presenting some first results on how social capital facilitates knowledge sharing and learning to potentially strengthen farm resilience in terms of robustness, adaptation, and transformation.

This paper builds on data originating from four methods. It draws on qualitative data from semi-structured interviews, focus groups, and expert interviews and quantitative data from farmer surveys to explore how social capital, learning processes, and learning outcomes have the potential to strengthen robustness, adaptation, and transformation. We study intensive arable farmers from the Veenkoloniën and Oldambt (the Netherlands) who grow starch potato and winter wheat as main crops, rotated with sugar beet and rapeseed.

2. Conceptualising how social capital and learning relate to the resilience capacities

To understand how social capital and learning relate to farm resilience, we build on the framework of De Kraker (2017). This framework describes how learning may impact resilience through the following four stages: (i) the setting to foster learning, (ii) learning processes, (iii) learning outcomes, and (iv) impact on resilience (Fig. 1). While De Kraker (2017) applies this framework to social learning, we apply this framework to both social and individual learning (Suškevičs et al.,

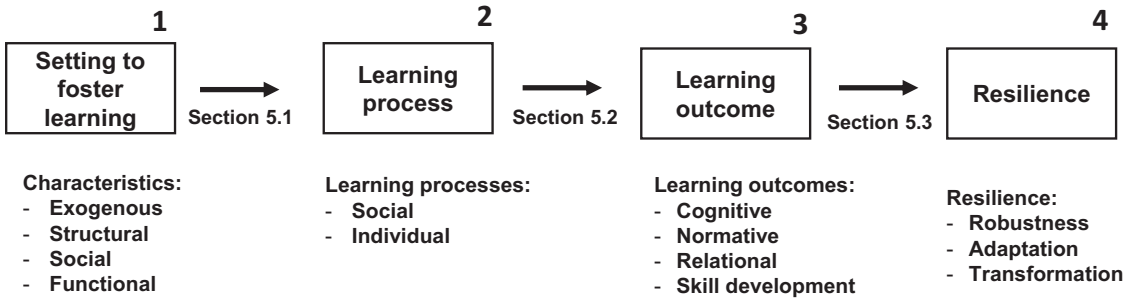

Fig. 1. Conceptual framework that describes how learning relates to farm resilience, adapted from De Kraker (2017). Sections refer to the sections discussing a specific stage of the framework.

2018). Specific attention is paid to how social capital enables or constrains farmers to learn and how this may be related to resilience.

2.1. Moving from learning to resilience

The setting to foster learning describes the physical and social context that stimulates or constrains learning processes. Exogenous factors, such as risks faced by farmers or new regulations, relate to the setting to learn. These exogenous factors are associated with a farmer's motivation to learn by shaping the perceived frequency, severity, and direct involvement with risk (Leeuwis and van den Ban, 2004). We distinguish three physical and/or social characteristics that relate to the setting to learn: (i) structural characteristics, (ii) social characteristics, and (iii) functional characteristics (Gerlak and Heikkila, 2011). These three characteristics are associated with the learning processes to be initiated. Structural and social characteristics primarily relate to social learning processes and functional characteristics may facilitate both individual and social learning processes. First, structural characteristics describe how learning is structured between farms and other actors. This is related to the institutional design that describes the formal rules in which farms operate (e.g. policies, regulations, and market structures) and the degree of integration between actors, which is shaped by farmers' social capital (Joffre et al., 2019). Second, social characteristics are the relationships and communication patterns among actors that are related to farmers' social capital (Gerlak and Heikkila, 2011). Examples of these social characteristics are trust (Joffre et al., 2020), the willingness to share information, take risk, or experiment with others (Lipshitz et al., 2002), and the existence of leaders (Gerlak and Heikkila, 2011). Leaders are early adopters of innovations that may or may not facilitate learning processes depending on their willingness to share information. Third, the functional domain is about what and how information can be shared (Gerlak and Heikkila, 2011). Social capital may facilitate information sharing to foster both social learning (e.g. study clubs) and individual learning (e.g. having access to information on the internet that is shared by others).

The second stage describes the social and individual learning processes adopted by farmers. Learning processes exploit the setting to foster learning by describing how and with whom farmers learn. Examples of learning processes are experimentation (Ingram, 2010), being open to new ideas (Darnhofer, 2010), learning from others (Ingram, 2010), seeking out new information (Suškevičs et al., 2018), learning new skills (Conley and Udry, 2010), being flexible (Carlisle, 2014), and reflexivity (Sinclair et al., 2017).

The third stage investigates how learning processes relate to learning outcomes. Learning outcomes can be changes in the structural, social, and functional characteristics of the learning setting described in stage 1. We distinguish four types of learning outcomes: (i) cognitive changes, (ii) normative changes, (iii) relational changes, and (iv) skill development. While the classification of cognitive, normative, and relational learning has been developed in earlier studies (e.g. Huitema et al., 2010; Haug et al., 2011; Baird et al., 2014), we add skill development as a fourth learning outcome because farmers often learn by doing, trial-and-error, and experimentation to develop practical skills. Cognitive learning outcomes reflect changes in knowledge acquisition and creation (Albert et al., 2012) or an increased understanding of risk and uncertainty (Baird et al., 2014). Normative learning outcomes are changes in perceptions, preferences, attitudes, values or norms that potentially affect decision-making (Baird et al., 2014). Relational learning outcomes are changes in attitudes and/or perceptions towards existing relationships (Suškevičs et al., 2018) or changing relationships—e.g. building trust or solving conflicts (Muro and Jeffrey, 2008). Finally, skill development may lead to improved social and communicative skills (Albert et al., 2012), a better ability to deal with uncertainty and change (Folke, 2016), and acquired task-oriented and/or technical skills, including learning how to use new technologies (Sinclair et al., 2017). It is still being debated whether the four learning outcomes are hierarchically interrelated or can be studied in isolation. Studies that have described this hierarchical interrelationship are embedded within the single, double, and triple-loop learning literature. While single-loop learning tends to be associated with cognitive learning outcomes, double and triple-loop learning may require 'deeper' normative learning outcomes (Armitage et al., 2008). However, Baird et al. (2014), describe that these interrelations in learning outcomes do not always hold and can be in conflict with other learning outcomes. For instance, normative learning outcomes do not necessarily have to be the result of cognitive learning outcomes. Therefore, we study the four learning outcomes in isolation without considering any hierarchical interrelationships.

The fourth stage explains how learning outcomes relate to farm resilience. Learning outcomes could help farmers to shape their responses to shocks and stresses. If these responses to shocks and stresses reveal on-farm changes, this could impact farm resilience along the dimensions of robustness, adaptation, or transformation (De Kraker, 2017). One should be aware that not all learning outcomes necessarily lead to behavioural changes (Muro and Jeffrey, 2008). It could also be the case that changes in perception, values, and norms reflecting learning outcomes do not lead to short-term observable behavioural changes but may make farmers open to new ideas in the longer term to prompt on-farm changes.

2.2. How social capital facilitates learning and impacts farm resilience

Social capital plays a key role in how farmers learn, as it shapes the structural, social, and functional characteristics of the learning setting. It facilitates learning processes as sharing knowledge relates to whom you know and the nature of these relationships (Kilpatrick et al., 1999). These learning processes could result in learning outcomes that reveal changes in resilience.

We distinguish between three types of social capital: bonding, bridging, and linking social capital (Szreter and Woolcock, 2004). Bonding social capital relates to informal relationships with similar actors that are trusted, willing to cooperate, and have strong ties (Klerkx and Proctor, 2013). These informal networks include farmers'

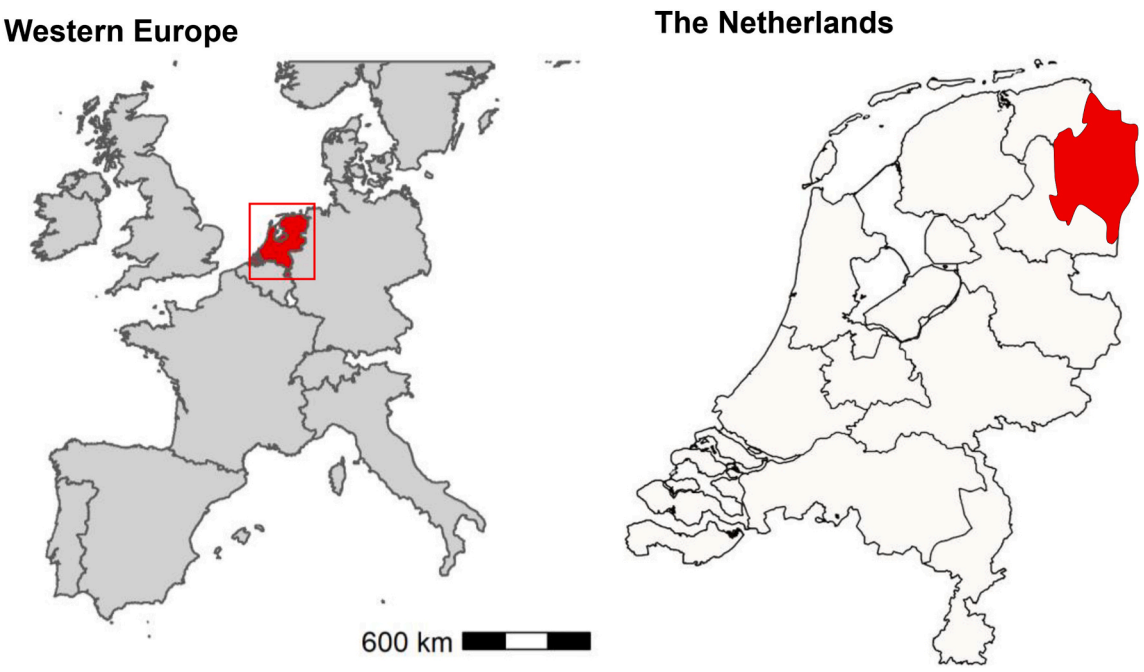

Fig. 2. Study area. The borders of the Dutch map represent province borders.

relationships to close friends, family, and farming colleagues that mostly relate to farmers' agricultural knowledge (Hunecke et al., 2017). Bridging social capital refers to relations between actors that are less similar and consist of more formal relationships with less trust and weaker ties (Cofré-Bravo et al., 2019). Such relationships could be between farmers and agronomists or other advisors. Linking social capital is described by farmers' most formal relationships with actors or institutions that share few similarities and often differ in terms of power, reflecting vertical relationships rather than horizontal ones (Szreter and Woolcock, 2004)—e.g. communication between farmers and local governments—which could provide farmers with information about radically new ideas (Hunecke et al., 2017).

Different combinations of bonding, bridging and linking social capital relate to what learning processes are facilitated and what knowledge is shared (King et al., 2019). For instance, bonding social capital could stimulate learning processes with peers about agricultural practices, potentially resulting in more complete information about existing farm practices. We expect that this helps farmers to make better-informed decisions related to agriculture and has the potential to enhance robustness. Bridging and linking social capital could facilitate learning processes in which farmers learn from more formal relationships that share fewer similarities (Cofré-Bravo et al., 2019). These learning processes allow farmers to learn about innovations or radically new ideas, potentially enabling farmers to change. Following Barnes et al. (2017), we expect that primarily bridging and linking social capital are associated with, respectively, adaptation and transformation.

3. Case study

We study the resilience of intensive arable farms from the Veenkoloniën and Oldambt, a region located in the north-east of the Netherlands (Fig. 2). Most of the agricultural land is used for arable farming practices. The region follows the general trend of reducing farm numbers while the remaining farms increase in farm size (Spiegel et al., 2021). The region is characterised by different soil types ranging from peat soils that are mixed with sand to heavy clay soil, where only limited crop rotation schemes are possible. Starch potato and winter wheat function as main crops, rotated with mostly sugar beet and rapeseed. Recently, arable farmers have started to experiment with new crops, including onions, blueberries, carrots, and bulb flowers.

4. Data and methods

We combined several methods used in the SURE-Farm[1] project, which aims to investigate the sustainability and resilience of farming systems in eleven European case studies. This paper builds on data from the Dutch case study. The following four methods were used: (i) semi-structured farmer interviews, (ii) farmer surveys, (iii) a focus group with farmers and other local stakeholders, and (iv) expert interviews with local experts who had extensive knowledge about past and current developments in the case study region. Table 1 provides a chronological overview of the methods and data collection. Each stage of the conceptual framework has been addressed by at least two methods. Data collection took place between April 2018 and November 2019.

No mixed methods design was used, indicating that we first collected the data and later compared these datasets to the conceptual framework introduced in Section 2. All methods discussed the following: farmers' capacity to learn, social capital, regional shocks and stresses, and resilience. These common themes allowed us to compare datasets across methods. All respondents participating in any of the methods were provided with information about the study to enable them to decide whether to take part and were asked to sign a consent form before data collection to indicate their willingness to participate.

Datasets were separately analysed and compared for convergence, complementarity, and divergence (Nightingale, 2009). The validity increases if triangulation revealed that results converge into a common understanding across methods (Carter et al., 2014). To identify sufficiently large sample sizes for the qualitative methods, criteria based on data saturation were adopted. Data saturation occurs if increasing the sample size does not introduce new themes or findings (Saunders et al., 2018). Although the presented sample size of each qualitative method in Table 1 could be considered small, we argue that data saturation can still be obtained if triangulation reveals convergence across methods (Fusch and Ness, 2015). This implies that a common understanding, verified by different methods, can be used to secure the overall validity, despite

[1] SURE-Farm: towards SUstainable and REsilient FARMing systems.

Table 1
Overview of methods and data collection, ordered chronologically.

Method	Actors involved in a method	Timing	Number of respondents	Stages conceptual framework
Semi-structured interviews	Farmer	June–December 2018	10	1, 2, 3, and 4
Survey	Farmer	November–December 2018	71	2, 3, and 4
Focus group	Farmer and local stakeholders (2 arable farmers, policy maker, agricultural insurer, crop protection producer)	September 2019	5 participants (1 focus group)	1, 2, and 3
Expert interviews	Local experts (regional innovation platform and starch potato cooperative)	April 2018 and November 2019	2	1

being limited by the small sample size of each qualitative method.

4.1. Semi-structured interviews

Ten qualitative semi-structured interviews with arable farmers were conducted; participants were recruited with the assistance of gatekeepers from (young) farmer organisations, local study clubs, and innovation platforms. All interviews were conducted in person by the same interviewer. 49 farmers were approached by e-mail, followed up by phone calls, resulting in a response rate of 20%. Purposive sampling was used to cover a diverse range of farmers, of which some farms went through big changes while other farms have remained stable over time. This variety of farms increases our understanding of robustness, adaptation, and transformation. Additional sampling characteristics were farm size, farmer age, and crop rotations. The interviews lasted between 50 and 95 min and were conducted in the period June–December 2018. All interviews were audio-recorded and transcribed verbatim. An analytical memo was written to briefly reflect on each interview and summarise key findings. The interviews discussed the farm history, on-farm changes in the past 10–20 years and farmers' experience with learning and social capital. Learning outcomes were inferred from the semi-structured interviews. Social capital was elicited using influence maps, which captured farmers' networks of influence to better understand the setting in which social learning takes place by interactively mapping the main influencers that shape decision-making (Oreszczyn et al., 2010). Farmers were asked to place all actors influencing their daily decision-making on a circular grid consisting of six circles. The most influential actors were placed in the central circle of the grid (1) and the least influential actors were placed in the most outside circle (6). Afterwards, participants were asked to describe how certain actors influenced their decision-making, how often they were in contact with these actors, and what kind of information was shared with these actors. Furthermore, participants described their relationships with several actors in terms of trust, norms, and values. The completed influence maps were photographed and the data was recorded in an Excel-file.

The interviews were thematically analysed based on a pre-designed codebook (Urquhart et al., 2019). The codebook identified the four stages of the conceptual framework by classifying: (i) how farmers have dealt with shocks and stresses and who influenced decisions (stage 1), (ii) learning processes (stage 2), (iii) learning outcomes (stage 3), and (iv) on-farm changes in the past 20 years (stage 4). Stage 4 was inferred from the interviews, indicating that we derived the revealed resilience capacities of a farm by studying the changes or stability of a farm over time. We distinguished between farms that maintained the status quo by absorbing the consequences of shocks and stresses (robustness) from farms that changed inputs and outputs over time (adaptation), such as experimenting with new crops or early-adopting innovations. Finally, those farms that went through radical changes were classified as being transformed. ATLAS.ti (version 9.0) was used to code the interviews (Muhr, 2013).

4.2. Survey

The quantitative survey measured farmers' (i) learning processes adopted in the last five years, (ii) learning outcomes, and (iii) perceived robustness, adaptability, and transformability. The survey used closed questions; most of them were based on a 7-point Likert scale. The specific wording of all statements and descriptive statistics can be found in Appendix 1. Farmers completed the survey in the period November–December 2018. The survey was sent out by email to a random sample of about 9000 Dutch farmers by a major agricultural publisher. Note that the survey was sent out to Dutch farmers in general, including farmers that were not located in the case study region and/or different farm types. This resulted in a total sample of 1537 respondents (17% response rate) of which a subset of 71 arable farmers from Northern and Eastern Netherlands was selected to match our case study based on a geographical indicator that approximately matched the case study region. The low response rate can be explained by the fact that the survey has been sent out by e-mail, which can be easily ignored. It took approximately 30 min to complete the survey. For more details on the survey design, pre-testing, data availability, and assessments of internal consistency reliability, convergent validity, and discriminant validity, see Slijper et al. (2020).

The survey investigated which learning processes were most often adopted by farmers (stage 2). Furthermore, we explored if farmers who had actively learned about agricultural risk in the past five years differ from farmers who had not learned in terms of several learning outcomes (stage 3) and perceived resilience capacities (stage 4) using the Mann-Whitney *U* test. Non-parametric tests were used because of the ordinal measurement scale resulting from Likert items.

4.3. Focus group

The qualitative focus group investigated how farmers and other regional stakeholders perceived (i) the setting to foster learning by studying shocks and stresses, (ii) social capital, and (iii) learning processes and outcomes. Participants were recruited using the network of a local innovation platform and experimental farm. Purposive sampling yielded five participants (two arable farmers, a local policy maker, a representative of an agricultural insurance company, and a crop protection producer), representing different stakeholders of farmers' social networks. The focus group was conducted in September 2019 and lasted approximately 3 h. The researchers took notes during the focus group to describe farmers' networks and social capital, the existing relationships, and how each of the network actors facilitated or constrained learning processes. Participants were asked to individually complete forms to describe the existing social networks of arable farmers from the Veenkoloniën and Oldambt. Additionally, participants were asked to describe the role of each actor in this social network and existing relationships between network actors. Afterwards, a plenary discussion followed to reflect on the findings and look for convergence of results. The individually completed forms, notes, and other collected data were analysed using thematic coding based on a pre-designed codebook to investigate the role of each actor in the setting to foster learning, learning processes, and learning outcomes. Two researchers, who both attended the focus group, analysed the data. Disagreements about coding were bilaterally discussed to reach a consensus. Bertolozzi-Caredio et al. (2021) provide more details on the methodology and analysis of

the focus group.

4.4. Expert interviews

Two expert interviews were conducted. The first expert worked at the research and development department of a large starch potato cooperative; the second expert worked for a local innovation platform. Both experts had a good overview of past developments in the case study region. Both interviews lasted approximately 60 min; interviews were audio-recorded and summarised afterwards. Short analytical memos were taken directly after each interview to summarise key findings. The first expert interview was conducted before the start of all other data collection (April 2018). We discussed the current setting to learn, social capital, and the most important shocks and stresses in the region. During the second expert interview (conducted in November 2019), we verified the findings from the other methods and reflected on recent changes in the regional learning setting and learning platforms.

5. Results

5.1. Moving from the setting to foster learning to learning processes

5.1.1. How the current setting to foster learning relates to learning processes

Table 2 describes the current setting to foster learning and how the setting to foster learning is related to farmers' learning processes. This is based on the semi-structured interviews, focus groups, and expert interviews. In general, our findings converged into a common description of the setting to foster learning. The most important exogenous factors affecting the setting to foster learning were extreme weather events and climate change.

The structural characteristics described the integration and engagement in social networks and the regulations affecting farmers. Our results revealed that farmers engaged in social networks were more likely to start new learning processes by having improved access to information and being better able to learn from others. Changes in regulations affecting farmers were the shift from coupled to decoupled CAP-payments, which decreased these payments from 450 to 750 €/ha to 350–400 €/ha (Spiegel et al., 2021) or new crop protection regulations, such as the recent ban on neonicotinoids and glyphosate. Both were perceived as barriers to learn. In case of the crop protection regulations, farmers indicated that the sudden introduction of these changes and the lack of a suitable alternative restricted them to learn.

High levels of trust were consistently described by all three methods as a social characteristic to foster learning. Our findings also revealed some divergence across methods. For instance, the semi-structured interviews indicated that farmers with a strong self-identity were less open to learn, while the expert interviews illustrated that farmers who strongly identified themselves with agriculture could be either more or less open to learn, depending on what is learned. Strong agricultural self-identities fostered the setting to learn about agricultural practices, while these farmers were less likely to learn about new ideas or business models. Two constraining factors for learning processes were identified. First, traditional subjective norms and values (e.g. the son should take over the farm and not the daughter or a farm should not diversify into non-agricultural activities) constrained farmers' openness to new ideas. Second, some innovative farmer leaders were not willing to share information with other farmers. For example, one of the first introducers of blueberries was not keen on sharing production details. While many farmers indicated an interest in learning about blueberries, the leader was not willing to share information to protect his status as the main supplier of blueberries.

The functional characteristics described existing learning platforms that were frequently used by farmers. Access to information (on e.g. social media, WhatsApp, internet, or study club) was consistently listed as a good starting point to foster learning.

5.1.2. How social capital relates to the setting to foster learning

To investigate how social capital in associated with the learning setting, we described farmers' networks and their existing relationships in relation to learning processes. We investigated which network actors facilitate learning on a continuum ranging from informal to formal networks. Table 3 shows that there were seven key actors involved in farmers' social networks: (i) people on the farm and farming colleagues, (ii) advisors, (iii) cooperatives, (iv) insurance companies, (v) banks, (vi) media, and (vii) local, regional, and national governments. Most findings converged across methods, as all network actors were consistently identified by at least two methods in terms of mutual dependence or a unilateral relationship. Power differences were reflected by unilateral relationships, which imply that a network actor affected farmers but that farmers did not affect the network actor. We briefly discuss two actors that were subject to divergence across methods: advisors and insurance companies. During the focus group, advisors were excluded from social networks as participants indicated that there was an overlap between the role of advisors and cooperatives. Cooperatives often employed representatives who regularly visited farms and acted as advisors. During the semi-structured interviews, farmers indicated that insurance companies were not considered to be network actors and had no influence on their decisions, while the focus group and expert interviews suggested that insurance companies were part of farmers' networks.

In line with Klerkx and Proctor (2013), we found that farmers' informal networks contributed to bonding social capital resulting from informal relationships with strong ties, high levels of trust, and shared norms and values. Informal networks had a greater influence on decision-making than actors that were part of formal networks. Often, informal actors facilitated learning processes by providing agricultural-related information. Relationships that moved in the direction of formal

Table 2
Key characteristics of the current setting to foster learning. + indicates that a characteristic fosters the adoption of learning processes. - indicates that a characteristic constrains the adoption of learning processes +/− indicates that characteristics could either foster or constrain the adoption of learning processes. Empty cells imply that a characteristic was not discussed.

	Key characteristics	Semi-structured interviews[1]	Focus group	Expert interviews
Exogenous factors	Climate change and/or extreme weather events	+	+	+
	Low societal acceptance of agriculture	−	−	
	Market circumstances			+
Structural characteristics	High engagement in social networks	+	+	+
	Strict and/or changing regulations	−	−	−
Social characteristics	Traditional subjective norms	−		
	Leaders who were not willing to share information on innovations		−	−
	Strong self-identity as a farmer	−		+/−
	Trust	+	+	+
Functional characteristics	Access to information (e.g. social media, WhatsApp, internet or study clubs)	+	+	+

Notes: [1] Characteristics are included if they were mentioned during at least 50% of the semi-structured interviews or being discussed during the focus group or expert interviews.

Table 3
Comparison of the actors involved in farmers' social networks, ranging from informal relationships (informal network) to formal relationships (formal network). Mutual or unilateral reflects the influential nature of the relationship. Mutual indicates that the farm and the actor both influence each other. Unilateral indicates that the actor influences the farm, but the farm does not influence the actor.

	Actor	Semi-structured interviews[1]	Focus group	Expert interviews[2]
Informal network	People on the farm and farming colleagues	Mutual	Mutual	Mutual
↓	Advisors (e.g. agronomist, accountant)	Mutual		Mutual
↓	Cooperatives	Mutual	Mutual	Mutual
↓	Insurance company		Unilateral	Unilateral
↓	Bank	Unilateral	Unilateral	Unilateral
↓	Media (e.g. social media, news)	Unilateral		Unilateral
Formal network	Local, regional, and national government	Unilateral	Unilateral	

Notes: [1]Actors are included if they were mentioned by at least 50% of the influence maps. [2] Based on the first expert interview.

networks were characterised by slightly weaker ties and lower trust. Hence, these actors had less influence on daily decision-making. If farmers learned from their formal networks, it typically contributed to bridging and linking social capital by providing new sources of information, sometimes even leading to radically new ideas. In general, we found that less formal relationships contributed to bonding social capital and that the most formal relationships contributed to linking social capital (Cofré-Bravo et al., 2019). However, not all farmers were able to build linking social capital. Often, red tape and too formal ties, as a result of large power differences, were listed as constraining factors by farmers to learn from their formal networks.

5.2. Moving from learning processes to learning outcomes

Most of the identified learning outcomes reflect changes in knowledge, behaviour, social networks, or skills. In line with Ensor and Harvey (2015), we found that not all learning processes resulted in learning outcomes, implying that not all learning processes necessarily resulted in changes in knowledge, behaviour, social networks, or skills. Table 4 presents an overview of these learning processes that were associated with learning outcomes based on the semi-structured interviews, focus group, and surveys.

Our findings revealed that learning is a non-linear and cumulative process, which is often shaped by multiple iterations of learning processes and learning outcomes (see e.g. Leeuwis and van den Ban, 2004; Ensor and Harvey, 2015). This was demonstrated by a farmer who had learned about installing solar panels after multiple learning processes and outcomes. At first, the farmer learned from others by visiting farms with solar panels, resulting in an increased interest in solar panels (normative learning outcome). Based on this increased interest in solar panels, the farmer started a new learning process by seeking out financial information about the costs and benefits of solar panels, leading to a cognitive learning outcome—i.e. improved financial knowledge about solar panels.

The survey revealed three key learning processes adopted by a high percentage of farmers—seeking out information (62%), learning from others (59%), and reflexivity (58%). Other learning processes were adopted at a much lower rate. In general, our findings converged across methods as the semi-structured interviews revealed that all ten farmers had adopted these three learning processes. These learning processes were also discussed during the focus group. However, we also observed some complementary findings as two learning processes were discussed

Table 4
Comparison of learning processes and outcomes across methods.

Learning process	Examples demonstrating learning processes[1]	Learning outcome(s)[2]	Semi-structured interviews	Focus group	Survey (%)[3]
Seeking out information	- Individually seeking out information (e.g. (social) media, internet) - Seeking out information with others (e.g. study clubs, cooperating with colleagues)	Cognitive	X	X	62%
Learning from others	- Learning from farming colleagues - Learning from specialists and experts (e.g. agronomist, accountant, bank, contractor, attending network events or farming fairs)	Relational, skill development	X	X	59%
Reflexivity	- Learning from mistakes and successes - Reflecting on past and current farming practices (e.g. agricultural practices, diversification, financial position, openness to change)	Cognitive, normative	X	X	58%
Ability to be flexible	- Ability to respond flexibly to unexpected events - Ability to respond flexibly to expected risk (e.g. flexibility in harvesting to deal with weather risk)	Cognitive, skill development	X		35%
Learning new skills	- Learning about new farming practices (e.g. agricultural education, specialised courses, learning about technology, learning how to reorganize the farm, or learning how to run a Bed & Breakfast) - Learning social skills (e.g. chairing social events, decision-making, negotiating with supply chain partners)	Cognitive, relational, skill development	X		27%
Experimentation	- Experimentation with new crops - Experimentation with non-agricultural activities to spread risk (e.g. solar panels) - Experimentation with more sustainable technologies to improve soil health, farm inputs or farm practices	Cognitive, skill development	X	X	23%
Being open to new ideas	- Openness to adopt new technologies - Openness to learn about agricultural shocks, stresses, and risks	Cognitive, normative	X	X	7%

Notes: [1] The examples of learning processes are included in Table 4 if at least 5 farmers mentioned this learning process during the semi-structured interviews or if it was discussed during the focus group. [2] Learning outcomes refer to the most common learning outcomes associated with a learning process. [3] The percentage of farmers who had adopted a learning process is presented.

Table 5
Descriptive statistics to compare cognitive and normative learning outcomes of farmers who had actively learned about agricultural risk in the past five years with farmers who had not actively learned. Based on the farmer survey. All items were measured on a 7-point Likert scale.

		Mean		Median		p-value[1]
Category	Learning outcome	Not learned	Learned	Not learned	Learned	
	N	35	36	35	36	
Cognitive	Knowledge about challenges	4.77	5.22	5.00	6.00	0.076*
	Openness to innovation	3.81	4.50	4.00	4.25	0.078*
Normative	Perceived behavioural control	4.34	4.72	4.25	4.88	0.082*
	Willingness to take risk	4.19	4.51	4.80	4.60	0.416

Notes: [1]p-values of the Mann-Whitney U test are reported. *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

during the semi-structured interviews and surveys but not during the focus group—i.e. the ability to be flexible and learning new skills. A possible explanation for this could be that the focus group combined the views of regional stakeholders and farmers on current learning processes, while the semi-structured interviews and survey elicited learning processes that were adopted in the past. The combination of different stakeholders and time horizons could make some learning processes less relevant. Furthermore, Table 4 shows that learning processes mostly resulted in cognitive learning outcomes, while normative, relational, and skill development were less often listed as learning outcomes. It could be that cognitive learning outcomes were easier to describe by farmers and were, therefore, more often identified. More detailed examples of learning outcomes and their relationship to resilience will be discussed in Section 5.3.

Additionally, the survey investigated if farmers who had actively learned about agricultural risk in the past five years differ in terms of several learning outcomes from farmers who had not learned about agricultural risk in the past five years. Table 5 reveals that the median of farmers who had learned was significantly higher in terms of knowledge about risk, openness to innovation, and perceived behavioural control—i.e. a person's perceived ability to overcome obstacles in reaching one's goals (Ajzen, 2002)—while there were no significant differences in terms of willingness to take risk. Table A1 of the Appendix describes how we measured the latent constructs described in Table 5.

5.3. How learning outcomes are related to the resilience capacities

Most of the findings demonstrated that learning outcomes were associated with increased adaptation, while there were fewer cases that describe how learning outcomes related to robustness or transformation. Table 6 presents an overview of the learning outcomes associated with each resilience capacity and provides examples that revealed the resilience capacities. Note that not all learning outcomes resulted in on-farm changes and are therefore not always associated with a resilience capacity.

Robust farms maintained and optimised current production processes by persevering a stable financial position, having buffers, or making required investments to continue current production processes. These farmers accumulated agricultural knowledge and often developed agricultural-related skills, had strong self-identities, low willingness to take risk, and complied with traditional norms and values. Examples of these traditional norms are that farmers should primarily focus on agriculture and the existence of strict divisions between conventional and organic farming. During one of the semi-structured interviews, a farmer indicated to experience societal pressure to change towards more sustainable and organic farming practices. However, this farmer was not willing to change and focused on maintaining current production processes. Furthermore, learning outcomes that were associated with robustness relied on high bonding social capital combined with medium bridging social capital by sharing agricultural-related knowledge with

Table 6
Overview of the learning outcomes that are associated with the resilience capacities based on the semi-structured interviews.

Learning outcome (category)	Examples of learning outcomes associated with a resilience capacity	Resilience capacity	Examples of changes revealing a resilience capacity
Cognitive	- Increased knowledge of innovations, but being a late adopter - Increased knowledge of existing agricultural practices	Robustness	- Having buffers (e.g. machinery, labour, financial) - Small or required investments that maintain the current business focus (e.g. replacing depreciated buildings or machinery) - Stable financial position and performance despite facing shocks (e.g. droughts)
Normative	- Stronger traditional subjective norms and values - Lower willingness to take risk - Stronger self-identity as a farmer		
Relational	- Increased openness to agricultural ideas as a result of increased trust in informal networks (mostly bonding social capital) - More uncertainty about (not) having a farm successor		
Skill development	- Developed financial management or agricultural-related skills		
Cognitive	- Increased knowledge of innovation and being an early adopter	Adaptation	- Adapting to societal expectations regarding sustainability (e.g. installing solar panels or providing agricultural education) - Introducing new crops (e.g. onions or mustard) or technologies - Labour or farm input flexibility (e.g. cooperating with neighbours or having access to multiple input suppliers) - New marketing strategies (e.g. on-farm direct sales or direct sales to retailers)
Normative	- Higher self-efficacy - Medium willingness to take risk - More positive attitude towards new technologies		
Relational	- Combined bonding and bridging social capital from formal and informal networks to increase openness to new ideas		
Skill development	- Improved ability to be flexible (labour, harvesting) - Improved ability to cultivate new crops		
Cognitive	- Increased knowledge of radically new ideas	Transformation	- Changing farm type (e.g. changing from mixed farming to specialised arable farming) - Radically changing the business focus (e.g. from primarily arable farming to Bed & Breakfast)
Normative	- Critical reflection on long-term business focus, resulting in radically new beliefs and values - Higher willingness to take risk - More progressive subjective norms - Unlearned existing skills, knowledge, ideas or views		
Relational	- Built bridging and linking social capital from formal networks, resulting in increased openness to radically new ideas		
Skill development	- Developed agricultural and non-agricultural related skills, including social skills		

Table 7
Summary statistics comparing the perceived resilience of farmers who had actively learned about agricultural risk in the past five years to farmers who had not actively learned. Based on the farmer survey. All items were measured on a 7-point Likert scale.

	Mean		Median		p-value[1]
	Not learned	Learned	Not learned	Learned	
N	35	36	35	36	
Robustness	4.29	4.59	4.33	4.67	0.283
Adaptability	4.60	5.19	4.33	5.17	0.040**
Transformability	4.32	4.39	4.33	4.67	0.786

Notes: [1]p-value of the Mann-Whitney U test are reported. *p < 0.10, ** p < 0.05, *** p < 0.01.

other farmers to develop agricultural skills. Some robust farmers struggled with uncertainty about having a successor, often leading to maintaining the status quo (Inwood and Sharp, 2012).

Some farmers adapted by changing their agricultural inputs (e.g. labour) and outputs (e.g. introducing new crops). Others adapted to societal pressure towards more sustainable production by installing solar panels or providing agricultural education to teach citizens about sustainable farm practices. In line with previous studies, we found that learning outcomes associated with adaptation include being an early adopter of innovation resulting from increased knowledge or positive attitudes towards new technologies (Cofré-Bravo et al., 2019), having high self-efficacy (Grothmann and Patt, 2005), and the willingness to take risk to some extent (Slijper et al., 2020). . Adaptations were often associated with combinations of bonding and bridging social capital from informal and formal networks (Barnes et al., 2017). For instance, informal networks as a source of bonding social capital enabled learning from colleagues about improving labour flexibility, sharing machinery or changing crop rotations, while bridging social capital from more formal relationships (e.g. cooperatives or agronomists) related to adaptation by introducing farmers to new crops.

Transformed farms were characterised by changes in farm type (e.g. from mixed farming to arable farming) or big changes in the farm business focus (e.g. a Bed & Breakfast with agriculture as secondary activity). Consistent with the literature, we found that normative learning outcomes associated with transformations were radical changes in beliefs and values (De Kraker, 2017), progressive subjective norms after critical reflection on current farm practices (Tarnoczi, 2011), and a high willingness to take risk (Barnes et al., 2020). Additionally, farms that have transformed acquired knowledge of radically new ideas that often related to agricultural and non-agricultural skill development. Transformations potentially require unlearning existing skills, knowledge, ideas or views (see e.g. Morais-Storz and Nguyen, 2017). Unlearning is often triggered by crises that force farmers to transform. An example of this was changing local regulations that forced a farmer to sell his farm. This farmer started farming at a new location and changed from mixed farming practices to a specialised arable farm. This radical change required unlearning knowledge about livestock farming in order to learn about starting a new farm business and the related regulations of starting a new business. In line with Barnes et al. (2017), we found that transformations were associated with the exploitation of some degree of bridging social capital and high linking social capital from formal network actors (e.g. external or institutional actors). For instance, one of the farmers visited tourism fairs to meet local policy makers and tourist offices. The radically new ideas acquired from these actors was associated with changes in business focus from primarily farming to a Bed & Breakfast with agriculture as secondary activities, illustrating the importance of linking social capital in relation to transformations.

Table 7 compares the perceived robustness, adaptability, and transformability of farmers who had actively learned about agricultural risk in the past five years to those who had not learned about agricultural risk in the past five years, drawing on the survey data. The Appendix presents the items that were used to measure the three resilience capacities. Our findings revealed significantly higher medians for adaptation of farmers who had learned compared to farmers who had not learned. Although the mean and median scores of robustness and transformability from farmers who had learned were slightly higher, no significant differences were found. It remains uncertain if these findings confirm the results of the semi-structured interviews—which revealed that learning was associated most often with adaptation and that the contribution of learning to robustness and transformation was less often observed in our data—as no significant differences in terms of robustness and transformability were found.

6. Discussion

The aim of this study was to explore how social capital and learning are related to resilience. Our findings suggest that bonding, bridging, and linking social capital are likely to be important components of learning processes. To enhance the resilience capacities through learning, the importance of *what* is being learned by farmers (learning outcomes) should be underlined instead of focussing on *how* farmers learn (learning processes), as similar learning outcomes can be the result of different learning processes.

The relationship among social capital, learning, and the resilience capacities is also associated with general farm resilience. As the relationship between the resilience capacities and general farm resilience is context-dependent, case-study research could help to gain an understanding of this dynamic and complex relationship (Slijper et al., 2022). On the one hand, we found that some farms enhanced their resilience by remaining robust, obtaining stability, and optimising existing production processes in terms of financial viability. On the other hand, those farms that have adapted and transformed sacrificed some (short-term) financial viability to improve their flexibility and ability to change to strengthen their long-term resilience (Darnhofer, 2014). This illustrates trade-offs between short-term robustness and adaptation and transformation, which require the consideration of longer time-horizons and tend to pay more attention to the social and environmental dimensions. Below, we provide some reflections on how social capital and learning are of importance to explain these trade-offs between the resilience capacities.

Understanding various combinations of bonding, bridging, and linking social capital can help to understand resilience. Fig. 3 visualises how different combinations of social capital are related to the resilience capacities. We found that high bonding social capital, medium bridging social capital, and low linking social capital were associated with robust farms. These farmers often relied on closed networks consisting of relationships with family, farming colleagues, and potentially advisors, in which trust plays a key role. In line with Fisher (2013), our results reveal that trust enables learning processes that focus on sharing experiences, combining existing knowledge, and developing similar ideas, such as, knowledge exchange with peers. Trust helps to translate learning processes into learning outcomes (Kilpatrick et al., 1999), such as, increased knowledge about existing agricultural practices. This relates to robustness in terms of the ability to maintain current production processes.

Contrary to obtaining stability, adaptation relates to flexibility and the ability to change. This requires inflows from more open networks providing access to new information (Fisher, 2013). Farmers with medium bonding social capital, high bridging social capital, and low linking social capital were more likely to implement adaptive changes on their farms. Their networks often consisted of relationships with farming colleagues, advisors, cooperatives, and sometimes innovation platforms. These relationships granted farmers access to new information. For instance, by visiting experimental farms with other farmers to learn about cultivating onions on their land (learning process). This increased knowledge about new crops (learning outcome) motivated some farmers to adapt by permanently including onions in their crop rotations.

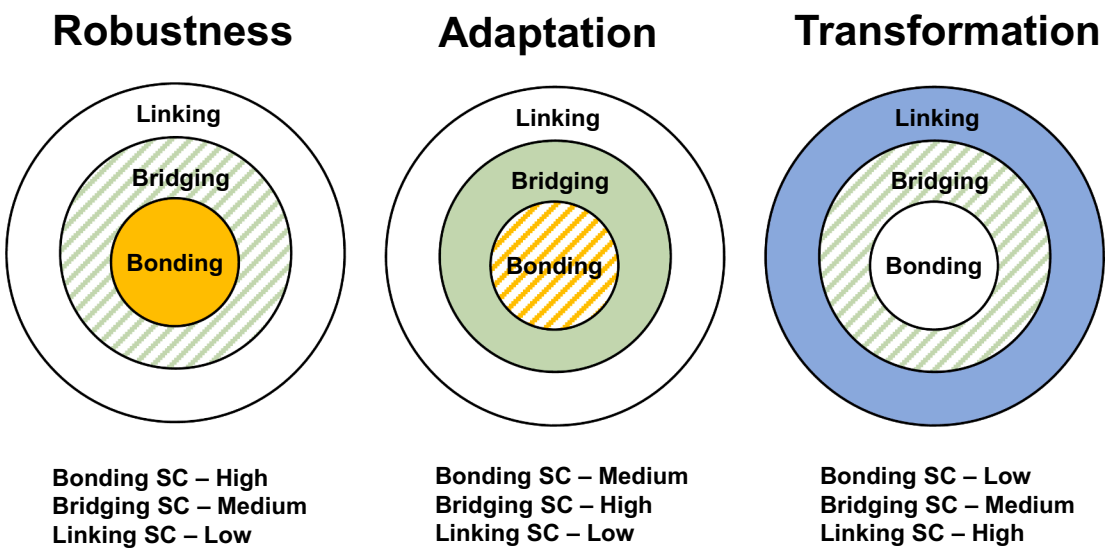

Fig. 3. Different combinations of bonding, bridging, and linking social capital (SC) are related to the resilience capacities. Filled circles indicate high levels of social capital, circles with diagonal lines imply medium levels of social capital, and circles with no fill reflect low levels of social capital.

Low bonding social capital, medium bridging social capital, and high linking social capital were related to transformations. Network configurations included relationships with advisors, local or regional government institutes, and non-agricultural actors. Especially for exploiting farmers' linking social capital, long-term relationships were important to build trust over time for effective transformations (Barnes et al., 2017). For instance, linking social capital facilitated learning processes by visiting visit tourism fairs and creating new relationships, resulting in higher trust and acquired knowledge about farm tourism as learning outcomes. This was associated with a transformation by changing the current farm focus to a Bed & Breakfast.

While balanced combinations of social capital have the potential to enhance resilience, imbalanced combinations of social capital may constrain resilience. We discuss some examples of these imbalances. Excessive bonding social capital relative to bridging and linking social capital may result in exclusive networks that are not open for new members, hampering learning about new ideas as most actors share a lot of similar knowledge (Portes, 1998; King et al., 2019). While this could be sufficient to maintain a robust farms, it could also result in a lower capacity to change (Tregear and Cooper, 2016) and potentially constrain adaptation and transformation. Additionally, high bridging social capital combined with a lack of bonding social capital could hamper learning processes due to a lack of trust (Tregear and Cooper, 2016). A lack of trust makes farmers less open to learn new ideas (Fisher, 2013) and potentially constrains adaptation. Finally, the role of linking capital in facilitating learning processes is potentially constrained by these few farmers that have access to information provided by formal networks. These farmers can constrain learning processes by potentially acting as gatekeepers and hamper learning processes (Cofré-Bravo et al., 2019). This may complicate the decision-making process about highly uncertain events, which could demotivate farmers to transform.

Furthermore, we reflect on the implications of methodological triangulation. The results mostly revealed convergence towards a common understanding, increasing the validity of our findings (Carter et al., 2014). There were also some cases of complementarity or divergence in our findings. We briefly discuss these findings and provide possible explanations in case of complementarity or divergence. Complementarity was found when investigating learning processes, as two learning processes—i.e. the ability to be flexible and learning new skills (Table 4)—were discussed during the semi-structured interviews and survey but not during the focus group. This highlights the added value of combining several methods because a more complete picture of farmers' learning processes was created. The comparison of farmers' social networks revealed some contradictions (Table 3). These diverging findings occurred for advisors and insurance companies that were classified as being part of farmers' social networks in two methods but were not understood as network actors in one method. This could be the result of differences in the actors involved that were involved in the methods.

Finally, we discuss three limitations of this study. First, while our findings provide detailed insights into Dutch arable farmers from the Veenkoloniën and Oldambt, the results are not generalisable and only remain valid in this specific agricultural context. Second, the qualitative methods employed in this study were based on small samples (10 semi-structured interviews, 1 focus group, and 2 expert interviews). This may raise the question if collecting more data would have improved our understanding of farmers' social capital, networks, learning, and resilience. Third, a note of caution is due as this paper provides some first exploratory results on how social capital can foster learning and its relationship to resilience. There are still some unanswered questions that could be investigated in future research, such as how changes in bonding, bridging, and linking social capital over time relate to resilience or how trust relates to social capital, learning, and resilience.

7. Conclusions

This paper explored how social capital and learning relate to the resilience of Dutch arable farmers from the Veenkoloniën and Oldambt. We used a combination of qualitative and quantitative data from semi-structured interviews, surveys, focus groups, and expert interviews. Methodological triangulation resulted mostly in convergence, indicating that there was a common interpretation of the findings of all methods that improved the validity of our findings. Learning was related to resilience as it helped farmers to acquire more complete information, which could help farmers to deal with the unknown. Social capital played a key role in facilitating learning processes and outcomes. While our results revealed that the relationship between learning and farm adaptation was mostly observed, we also found some cases where learning was associated with farms that remained robust or transformed. Robustness was associated with high bonding social capital and medium bridging social capital, as a result of farmers' informal networks with high levels of trust. Robust farmers learned mostly about existing agricultural practices. Farms that revealed adaptations exploited a combination of medium bonding and high bridging social capital, which related to an openness to new ideas from both informal and formal

networks. These new ideas were associated with farmers undertaking adaptation by adopting innovations and new technology. Transformations were related to high linking social capital and medium bridging social capital by enabling farmers to connect with their formal network and increasing their openness to radically new ideas. The farmers who were open to radically new ideas often introduced changes towards non-agricultural activities or changes in farm type.

This study has implications for European agricultural policy makers who aim to enhance farm resilience. The current CAP does not sufficiently address how social factors, including social capital and learning, play a role in facilitating robustness, adaptation and transformation. We have shown under which circumstances social capital and learning provide farmers more complete information. This has implications for designing better Agricultural Knowledge and Innovation Systems (AKIS), as we have described how farmers' social networks can improve their information exchange. Our results revealed that bridging and linking social capital, often built by farmers' formal ties (e.g. governments or insurance companies), play a key role in providing farmers access to radically new ideas, potentially stimulating farm adaptation or even transformation. However, the current relationship between farmers and formal network actors was perceived as being bureaucratic and impersonal, reducing farmers' willingness to learn. To enhance farm resilience, policy makers could stimulate a shift towards more personal ties of farmers' formal networks. Policy makers should try to reduce red tape to promote efficient and less formal information exchange by facilitating social learning with formal network actors or joint innovation programmes.

Declaration of Competing Interest

There is no conflict of interest.

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Appendix

Table A1

Item wordings and summary statistics to compare farmers who have actively learned to farmers that have not actively learned. Averages are presented if multiple items were used to measure a construct. All items were measured on a 7-point Likert scale ranging from 1 (fully disagree) to 7 (fully agree).

Item		Mean		
		All ($N = 71$)	Not learned ($N = 35$)	Learned ($N = 36$)
Knowledge				
know_1	I know a lot about agricultural challenges on my farm	5.00	4.77	5.22
Openness to innovation (average)		4.16	3.81	4.50
inno_1	Compared with other farmers, I am among the first to try out a new practice on my farm	4.06	3.69	4.42
inno_2	I like to try out all kinds of new technologies or varieties	4.27	3.94	4.58
Perceived behavioural control (average)		4.54	4.34	4.72
pbc_1	If I wanted to, it would be easy for me to deal with agricultural challenges on my farm	4.73	4.71	4.75
pbc_2	It is mostly up to me whether or not I can deal with the challenges on my farm	4.69	4.71	4.67
pbc_3	I have a lot of control about agricultural challenges affecting my farm	4.21	3.77	4.64
pbc_4	For me, it is difficult to deal with the challenges that affect my farm[1]	4.51	4.17	4.83
Willingness to take risk (average)		4.35	4.19	4.51
I am willing to take more risks than other farmers in terms of...				
riskpref_1	Production	4.45	4.23	4.67
riskpref_2	Marketing and prices	4.41	4.23	4.58
riskpref_3	Financial risks	4.17	4.20	4.14
riskpref_4	Innovation	4.28	3.97	4.58
riskpref_5	Farming in general	4.45	4.34	4.56
Robustness (average)		4.44	4.29	4.59
rob_1	After something challenging has happened, it is easy for my farm to bounce back to its current profitability.	4.54	4.43	4.64
rob_2	Personally, I find it easy to get back to normal after a setback.	4.56	4.37	4.75
rob_3	A big shock will not heavily affect me, as I have enough options to deal with this shock on my farm.	4.23	4.06	4.39
Adaptability (average)		4.90	4.60	5.19
adap_1	If needed, my farm can adopt new activities, varieties, or technologies in response to challenging situations.	4.82	4.54	5.08
adap_2	As a farmer, I can easily adapt myself to challenging situations.	4.90	4.66	5.14
adap_3	In times of change, I am good at adapting myself and facing up to agricultural challenges.	4.99	4.60	5.36
Transformability (average)		4.36	4.32	4.39
trans_1	For me, it is easy to make decisions that result in a transformation.	4.46	4.40	4.53
trans_2	After facing a challenging period on my farm, I still have the ability to radically reorganize my farm.	4.37	4.17	4.56
trans_3	If needed, I can easily make major changes that would transform my farm.	4.24	4.40	4.08

Notes: [1] Reversed scores of the negatively worded items are presented. If a construct was measured using more than 1 item, we used averages of multiple items to compute descriptive statistics in the paper.

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