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The resilience of Finnish farms: Exploring the interplay between agency and structure

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ABSTRACT

Resilience implies, in its essence, the capacity of a system to tolerate disturbances while retaining its essential functions. In the context of agriculture, resilience thinking calls for considering the ability of farms to thrive in turbulent times along with the ability of the ecological system – in which the agricultural production is embedded – to retain its function and integrity. Resilience is a relevant conceptual tool to analyse the contradictory management demands that farms are facing within the current neoliberal market regime: being economically viable and environmentally sustainable. In this study, the resilience of farms was operationalised through farmers' perceptions concerning their farms' development trajectories in these two dimensions. The operationalisation strategy applied to farm survey data from Finland suggested that the majority of Finnish farms were vulnerable in either or both of these dimensions. The resilient farms were characterised by large size, development orientation, possession of social capital and adoption of targeted agri-environmental measures. The agrifood system was characterised by increasing level of centralisation and connectedness affecting all systemic levels, including the farm systems. Resilience can be seen as a manifestation of a self-reinforcing virtuous cycle, in which both the farm structure and the farmer's agency are well aligned with the contemporary context, whereas vulnerability is the result of a similar, but vicious cycle.

Keywords: adaptive renewal cycle, agency-structure, agrifood system, farm system, resilience

1 Introduction

Agricultural farms and farmers in the context of the current neoliberal paradigm of industrial agriculture, the 'corporate food regime', are facing a two-fold challenge: retaining their competitiveness in order to stay in business while responding to the environmental challenges caused as externalities of current agricultural production practices (Darnhofer et al. 2016, Knickel et al. 2018, Milestad et al. 2012, Rizzo 2017). The terms of trade of agricultural production are, from the farmers' viewpoint, deteriorating along with increasing input prices and decreasing prices of agricultural products, which asks for more efficient farm management and pushes towards economies of scale – the farmers either have to "get big or get out" (Fletcher 2013). At the same time, farmers are expected to take on a stronger role regarding the management of environmental problems caused in the course of agricultural production, from biodiversity loss and water eutrophication to mitigating climate change and nurturing the fertility of soils (EEA 2017). From the outset, these two demands are partly incompatible, which highlights the role of farmers' capabilities and strategies in responding and adapting to them.

The responses of farmers to the challenges arising from these contradictory demands can be conceptualised in terms of resilience. The concept of resilience, relying upon the seminal work by Holling (1973), implies the capacity of a social-ecological system to tolerate disturbances while staying within the same domain of attraction, and thus retaining the essential functions, systemic feedbacks and structures (Walker et al. 2004). In the agrifood system context, resilience has been conceptualised variably (Ashkenazy et al. 2018), from perseverance of farms to maintaining food security, demonstrating the context-dependency of the concept (resilience of what to what; Carpenter et al. 2001). Because a social-ecological system consists of two dimensions – the social and the ecological – a resilient system should sustain both features (Folke et al. 2010). Consequently, the most essential function of resilience in an agrifood system can be defined as its ability to provide food for the human population within the limits of the local environmental carrying capacity (Meuwissen et al. 2019). Following this line of argumentation, I conceptualise resilience in terms of the system functions: a resilient farm provides food for the citizens, but does not do so at the expense of the environment – it provides both public and private goods and thus addresses the social and ecological function of the system (Meuwissen et al. 2019). Resilience is thus a relevant framework for analysing farms and farmers facing contradictory management demands.

A resilient system is not a stable system, but one that retains its essential functions through enduring stresses and transient shocks (Ashkenazy et al. 2018, Darnhofer et al. 2016). These stresses and shocks are imposed on the system within the dynamics of adaptive renewal cycles. The heuristics of the concept is based on an understanding of systems developing through repetitive phases of growth and saturation, and crisis and renewal. The phases of growth and saturation are called exploitation and conservation, respectively, and they form the relatively stable 'front-loop', the dominant regime, in which systems spend majority of their time (Gunderson and Holling 2002). The exploitation phase is marked by self-reinforcing feedback loops that boost the system's growth, while in the conservation phase, balancing elements are added to these feedbacks through e.g. increasing internal complexity of the system (Walker and Salt 2006). The endogenous contradictions of the system and/or exogenous disturbances can trip the system over a threshold and precipitate the release phase, where the old structures and connections of the system are broken (Holling 2001). A new systemic configuration emerges in the reorganisation phase, which together with the release phase form the 'back-loop', implying the renewal of the system (Gunderson and Holling 2002, Walker and Salt 2006).

The social-ecological resilience scholarship has been criticised for the cursory conceptualisation of the "social" within the social-ecological systems. This criticism calls for resilience research to more explicitly address the human agency in its various forms: in possessing goal-oriented, transformative capacity, being driven by conflicting interests and varying power positions, and in manifesting understanding and knowledge about the focal system (e.g. Cote and Nightingale 2012, Davidson 2010, Dwiartama and Rosin 2014, Fabinyi et al. 2014, Hatt 2013, Herman et al. 2018, Olsson 2015, Stojanovich et al. 2016, Šūmane et al. 2017). Lyon and Parkins (2013) argue that resilience research should bring the social, actor-oriented processes that are manifest in systemic adaptation and transformation to the centre stage, instead of relying on structural indicators that dismiss the varied perceptions of agents within the system. Whether a farm continues to operate and function as a farm system – that is, by producing food and public goods – is dependent upon the decisions made by the farmer (Darnhofer et al. 2010a, Raatikainen and Barron 2017), and these decisions stem from the perceptions and mental models the farmer holds (Beratan 2007, Meyfroidt 2012, Schlüter et al. 2017) – in short, how they perceive the possibilities and constraints and the viable choices available within their operational environment (Darnhofer et al. 2016). Thus, in this study the operationalisation strategy for resilience builds on farmers' perceptions rather than on external indicators.

Agency in social-ecological systems takes place within the possibilities and constraints defined by the external structure – according to how the system actors perceive and act on those possibilities and constraints. By referring to the systemic scales, it is possible to separate distinct layers of interaction: the actor possessing variable amounts of agency – in this case, the farmer, the immediate systemic context within which the interaction between agency and structure takes place – the farm system, and the external systemic context conditioning these interactions – the agrifood system. For this end, reference to the adaptive cycle can provide important insights. The adaptive cycle can be interpreted to represent a dynamically changing interplay between structure and agency, where the structure – i.e., the state of social-ecological system – serves as both enabling and constraining individual agency, depending on the development phase of the system. The conservation phase is typically marked by increasing systemic contradictions and trade-off situations due to the mounting connectedness within the system (Darnhofer et al. 2016). Such rigidity would suggest strengthening structural constraints on agency. The two-fold challenge – producing cheap food with minimal environmental impacts – faced by farmers can be interpreted as an implication of the constraining forces of the dominant agrifood regime growing stronger towards the conservation period. To understand the emergence of resilience at the farm level, I aim at characterising the resilience of farm systems as an interplay between agency and structure.

In this paper, my aim is to understand the emergence of resilience as an outcome of the interplay between farmers as focal agents in the farm systems managed by them and the larger agrifood system representing the structure that constrains and enables farmers' agency. Further, this interplay takes place in a context where the agrifood system is in the front-loop, arguably growing more rigid and connected. My empirical case comes from Finland, which offers an interesting vantage point to understanding these dynamics. In recent years, the Finnish agrifood system has experienced several developments that have had a profound impact especially on the farm systems: the centralisation process in the food chain has been strong, and farm income is falling despite increasing farm size. The developments were accentuated by trade bans to Russia since 2014 that hit hard especially the Finnish dairy sector. As a result, the profitability of agriculture has been described being in a state of crisis (Karhinen 2019). These developments have been accompanied by a heated public debate about the major role of farming in the eutrophication of surface waters and especially the Baltic Sea. Should these developments be understood as an oddity or outlier; a number of bad years passing by, or can they be seen as a manifestation of a stagnated agrifood system stuck in a conservation phase, downplaying the possibility for farmers to exercise their individual agency in shaping the future of this system? A possibility to understand the emergence of the situation in the present day is offered by taking a look at a cross-sectional farmer survey data dating back to 2010, a time characterised by relative stability within the agrifood system. Could the farmers be characterised as resilient at that time? What factors contributed to farmers being resilient or not? What can be said about the role of structural vs. individual factors in contributing to the observed resilience of farms, and based on this information, can we make conclusions about the developments observable in the present day?

In the rest of the paper, I first discuss the concept of resilience in relation to the agency–structure nexus within the framework of adaptive renewal cycles in section 2. To be able to interpret the case in the relevant context, I also discuss the development dynamics of the Finnish agrifood system in terms of the adaptive renewal cycles. In section 3, I present the data and methodology used in the study, and in section 4, the results of the statistical model. In section 5, I discuss the structuration process of farm-level resilience. I conclude by discussing the agency of farmers in striving for resilience within the current agrifood regime.

2 Background

2.1 The resilience of farm systems

The concept of resilience has been originally used in the field of ecology to depict the persistence of the main relationships within an ecological system to external disturbances, as in the case of predator-prey-relationships (Holling 1973). In its current usage in the context of social-ecological systems, the definitions for resilience stress on one hand the persistence of the functions, structures and essential feedbacks within a system (bounce-back type of resilience or persistence), and on the other, the capacity of a system to self-organise, learn and adapt to changing external circumstances while retaining those features (bounce-forward type of resilience or adaptation and transformation) (Davidson et al. 2016, Walker et al. 2004). While definitions for resilience stress the perseverance of functions, structures and feedbacks, the latter two must be subordinate to the former; the systemic function. By definition, complex adaptive systems such as social-ecological systems do no behave randomly, but emergence in these systems takes place to fulfil the systemic goals (Meadows 2008). In the case of agrifood systems, questions of resilience revolve around food provisioning and food security as the main function of the system to be preserved (Hodbod and Eakin 2015).

The agrifood system is not a single system, but an open, fuzzy, multi-scalar entity constructed of numerous subsystems embedded in each other both vertically and horizontally. The agrifood system at a national level contains regional food provisioning systems and local farm systems, while being itself a part of transnational food systems. At the same time, all these systems are also part of other social-ecological and socio-technical systems, such as rural and urban community systems, transportation systems and energy systems that all have their own adaptive cyclical dynamics (Holling 2001). Resilience does not thus take place in isolation. The changes in one systemic level may cascade through other levels, affecting the systemic assemblage as a whole (Holling 2001) – the resilience of the system in inspection is in its essence about how tolerant the focal system is towards these changes relative to its function.

When a farm system goes through the periods of exploitation, conservation, release and reorganisation within the adaptive renewal cycle, some of the structures of the system, its feedback mechanisms and even some of its functions may change. Farms may grow or shrink, they may change the line and type of production, they may choose to sell their products through different channels or give up production and convert to for example tourism. From the viewpoint of the farmer's livelihood, all these options may indicate resilience – the farm may either persist, adapt as in the case of growing, or transform as in the case of changing line of production or converting to non-agricultural activities. However, from the viewpoint of agrifood resilience, giving up agricultural production altogether at a farm means a loss of resilience. When a farm gives up production, the system switches attractors and moves into a new stability domain outside of agricultural production. The switch may indeed indicate resilience, but it is resilience from the viewpoint of the farmer or the rural community, not from the viewpoint of the agrifood system, as the farm ceases to contribute to the central function of food provision within the agrifood system. The agrifood system and rural community system are adjacent and embedded systems, but yet they are also different systems with distinct systemic functions, structures and feedback mechanisms. In this sense, resilience indeed lays in the eye of the beholder.

In the farming system context, resilience can mean in its simplest terms survival of the productive function of the farm despite the changing conditions (Puupponen et al. 2017). However, besides the ultimate goal of food provisioning, the farm system has to do this within the ecological carrying capacity of the focal system. Moreover, the farm system is both dependent upon and contributes to ecosystem services (such as pollination and water regulation). When assessing the resilience of farm systems, these aspects call for equal consideration (Allen et al. 2018). Meuwissen et al. (2019) define agrifood resilience as the ability of the system to deliver on the system functions, which they label as producing both public and private goods. Thus, a resilient farm is able to acquire a sufficient and sustained income for the farming family as well as providing public goods in the form of e.g. ecosystem services and mitigating the environmental harm.

Lyon and Parkins (2013, 532) argue that the social-ecological resilience literature has succeeded in providing an '"indicator-heavy" scholarship about the structural dynamics of resilience', and call for more understanding about the actor-oriented processes contributing to resilience. This 'indicator-heavy scholarship' is what Darnhofer et al. (2016) refer to as the structural approach to resilience. While such an approach to resilience may 'get the facts right' (Cote and Nightingale 2012, 482), it may fail to capture the process that essentially leads to emergence of resilience, if concentration upon indicators leaves the farmers' mindsets – indeed, their very agency – untouched. To address the agentic dimension of resilience, farmers' decision-making, perceptions and meaning making need to be accounted for, which is addressed in the agentic approach to resilience (Darnhofer et al. 2016). These conceptually differing approaches to resilience may also reflect differences in the methodological approaches: qualitative approaches typically address the dimensions of farmer meaning-making, perceptions and judgment, goal-seeking behaviour and practices, while the quantitative approach tends to aim at operationalising some central dimensions of the resilience concept, such as economic or environmental performance or multifunctionality. Bridging the gap between these approaches is a challenging task and will inevitably lead to further limitations, as capturing both processes related to agency and the material manifestations of resilience at the same time implies compromising either depth or breadth of the phenomenon. Quantitative indicators will always be able to capture only slices of the phenomenon they attempt to depict (Quandt 2016), and with qualitative approaches, it is difficult to evaluate the relevance of findings in relation to the whole population of farmers. Nevertheless, despite these challenges, such an approach can provide insights that neither strand could deliver in isolation.

In this study, instead of simply searching for evidence of farm performance in the domains of delivering public and private goods, I address farmers' perceptions of performance. In this approach, resilience does not simply depend upon the resources and potentials present at the farm, but rather upon the way the farmer perceives them (Darnhofer et al. 2016). Such an operationalisation strategy also resonates with the call for more explicitly accounting for the role of local knowledge in reorienting the agrifood systems towards more resilient paths, as prompted by Šūmane et al. (2017). Farmers have been found to have a profound and versatile understanding of the ecological interactions related to agricultural practices (Bernués et al. 2016, Kelemen et al. 2013, Smith and Sullivan 2014, Soini and Aakkula 2007). However, by tracing performance perceptions, it is not possible to infer the agri-environmental status or economic viability of the Finnish agrifood system per se. What the performance perceptions do reveal, however, is the farmers' relational position: if a farmer perceives good or bad performance, there must be conscious, reflexive reasoning grounded in the material reality behind these perceptions (Giddens 1984). Further, these reflections are likely to echo the adaptive capacity of farmers (Berkes and Ross 2013): perception in itself indicates how the individual farmers relate the issue to their own past experiences as well as their future expectations and goals (Giddens 1984). Such an understanding of resilience resonates with the third approach for conceptualising resilience as suggested by Darnhofer et al. (2016); the relational approach. Within this approach, resilience is seen to take place in emergent and unfolding sequences rather than one moment in time (Darnhofer et al. 2010a). These sequences are constituted by the material reality of the past, as in the path-dependent farm trajectory and farming practices, as well as by farmers' perceptions of causes and effects in the past, and by the future in how it reflects the goals and expectations of the farmer (Darnhofer et al. 2016). Both of these temporal dimensions are mingled in the present, in manifestations of farmers' agency in e.g. evaluating past experiences against future prospects for decision-making in the present (Darnhofer et al. 2016).

When having come to terms with how to interpret resilience in the case of farm systems, the question that yet needs addressing is what contributes to this resilience. Frequently discussed factors include social capital as manifested in, for example, cooperation with different social groups and engagement with governance institutions, utilisation of support mechanisms, adoption of innovations, entrepreneurial mindset, value-led decision-making, the approach of nurturing diversity and avoiding locked-in pathways, and management practices aiming for efficient use of resources (Ashkenazy et al. 2018, Darnhofer 2010, Herman et al. 2018, Knickel et al. 2018). Social capital is one of the most frequently mentioned factors enhancing resilience of farm systems (Ashkenazy et al. 2018, Cabell and Oelofse 2012, Herman et al. 2018, Sinclair et al. 2014) through mobilising collective agency and building adaptive capacity of the system within the networks and social relations of actors (Berkes and Ross 2013, Dwiartama and Rosin 2014). These factors represent mostly the agentic dimension in the agency-structure continuum but shed less light on what kind of alignments with the prevailing structure are required for the resilience of farm systems – are there structural prerequisites for farm-level resilience? Do the factors facilitating resilience play different roles in different contexts? Are all farms similarly positioned to strive for resilience? Hence, in this paper, my aim is to explicitly explore both factors reflecting farmers' agency (such as strategic decision-making and possession of social capital) as well as the factors tying the farms to specific structural configurations (such as farm size and line of production) in analysing the emergence of farm-level resilience.

Navigating through the qualitatively different phases of the adaptive cycle requires different kinds of capabilities and management orientation from the farmer, as discussed by Darnhofer et al. (2016). They note that the exploitation period is typically about searching for efficiency within the current agricultural regime, while conservation period in the larger agricultural system means less possibilities for choice and increased leverage from farm- and farmer-external forces. Conversely, the phases of release and reorganisation leave room for innovation and searching as a result of breakage of the systemic connections and freeing of the resources previously bound in the hands of few in the conservation phase (Darnhofer et al. 2016). The feasible strategies to strive for resilience in different phases of the adaptive renewal cycle may contradict each other as the needed capacities during times of incremental change do not equal those relevant in times of radical, transformative change (Ashkenazy et al. 2018, Cabell and Oelofse 2012, Darnhofer 2010, Holling 2001). This configuration implies that farmers' agency is attuned differently depending on the phase of the adaptive cycle both the farm and the agrifood systems are at. This is why the context in terms of the development of the agrifood system in Finland deserves further scrutiny and will be discussed next.

2.2 Development of the Finnish agricultural regime

Finland was a strongly agrarian society up until the aftermath of the Second World War. The industrialisation and intensification period started in the 1950s and was marked by increasing productivity of the agricultural sector along with the introduction of fossil-fuelled machinery as well as synthetic fertilisers and pesticides and protectionist subsidy and price policies (Kuhmonen and Niittykangas 2008). The regime based on intensification coupled with protectionism was transformed profoundly due to market liberalisation, which resulted from accession to the European Union in 1995. The liberalisation marked a swift release and reorganisation period of the Finnish agricultural regime as producer prices were cut by 40% to 60% immediately upon accession (Kuhmonen 1998). Approximately 30% of active farms in 1995 were closed by 2005 (Niemi and Ahlstedt 2005). The structural development of the Finnish farming sector has followed the same trends as the rest of Europe and the western world, resulting in a reduced number of farms, increased average farm size and concentration of land ownership (van der Ploeg 2017). Despite the increase in farm size and agricultural output per farm, the average income per farm has fallen 33% from 2000 to 2018 (Natural Resources Institute Finland Statistics).

Joining the EU meant not only the liberalisation of the agricultural markets, but also the introduction of agri-environmental policies. These policies exposed farmers to new management demands to take into account the environmental effects of agriculture more explicitly (Aakkula et al. 2006, Kröger 2009). Such a development, observable around the industrialised world, has been described by Lamine (2014) as the takeover by the corporate environmental food regime. The agri-environmental policies were widely adopted by Finnish farmers from the very beginning. Around the time the survey for this study was conducted in 2010, the dominant themes for agri-environmental management were nutrient management and biodiversity protection. The need for environmental management within agriculture has been addressed with rural development programmes that encourage farmers to adopt both general and targeted environmental management practices. The survey was conducted during the third programming period in 2007–2013.

In terms of the adaptive renewal cycle, accession to the EU in 1995 meant a period of release and reorganisation in the Finnish agrifood system. The survey was conducted during the front-loop of adaptive cycle with exploitation phase progressing towards conservation, within a regime characterised by globalised markets, rising neoliberal market ideologies, corporate power and environmental concerns. For farms, this has meant an enduring stress of improving both economic competitiveness and environmental management and a need to adapt to the price shocks of the global, neoliberal agricultural regime. In terms of resilience, the period of exploitation means incremental rather than radical change and highlights the role of continuous improvement of efficiency of farm management (Darnhofer et al. 2016). The recent years have witnessed deepening hardships for Finnish farms with an economic situation characterised being in a state of crisis (Karhinen 2019). The resources within the agrifood system are seen to accumulate in the hands of few, especially manifest in the oligopolistic market situation in trade and retail (Karhinen 2019, Paloviita et al. 2017). The wide-scale agricultural support system has been criticised for not delivering the environmental benefits expected of it, and for the support money ending up in unintended places, such as unreasonably high prices of agricultural land or to the input suppliers and even trade and retail actors. These developments seem to indicate a conservation phase, where the trade-offs between the various dimensions of the system have become visible, growth has stagnated, resources have become tightly bound and connectedness increased the internal complexity of the system (Holling 2001). Referring to a survey data from 2010 offers a unique opportunity to understanding the roots of these developments. While many of these developments have culminated in the recent years, how early is it possible to observe signs of them from the farmer viewpoint? In this study, I seek to contribute to understanding the effect that the phase of adaptive renewal cycle in the agrifood system has on its subsystems, the individual farms, and how these effects spread within the farm population – what factors enhance the resilience of farms and which factors cause vulnerability.

3 Research design

In the following, I will offer a general description of the research process aimed at 1) describing the resilience of Finnish farms from the farmer perspective in terms of a farm typology, 2) exploring factors characterising resilient and vulnerable farms and 3) discussing the implications of the findings in relation to the development dynamics of the Finnish agrifood system. In subchapters 3.1 – 3.4, I will offer a more detailed description of the research design. The data that the study is based on is a quantitative, cross-sectional farmer survey data dating back to 2010. Resilience was operationalised by forming a typology based on farmers' perceptions of their farms' performance in environmental and economic domains. The typology resulted with four groups: the resilient group and three groups that were vulnerable in both or either of the dimensions of economy and environment. To explore the factors that contributed to the positioning of the farms in each of these groups, the statistical method of logistic regression was utilised.

3.1 Data

This research is based on the data collected during the mid-term evaluation of the Rural Development Programme for Mainland Finland 2007–2013 in 2010 (Kuhmonen et al. 2010). A survey request was sent to all farmers having email addresses in the farm register (IACS), altogether about 23,000 farmers. The data consist of 2,124 responses, for a response rate of 9.2%. The number of farms in Finland at the time of the survey was approximately 60,000, meaning that roughly one third of farmers had stored their email address in the system. In the data, larger farms and younger farmers are slightly overrepresented (table 1), partly due to younger farmers and owners of large farms having registered their email addresses in the farm register more frequently than older farmers and small farm owners did. Despite this slight bias, the data can be considered valid to represent the Finnish farm population. The survey covered all lines of production and the whole mainland area.

Table 1. Representativeness of the data (comparison data source: Natural Resources Institute Finland).

Line of production	**Survey farms %**	**All farms (2010) %**	**Farm size (ha)**	**Survey farms %**	**All farms (2010) %**	**Age**	**Survey farms %**	**All farms (2010) %**
Dairy	18	18	14.99 or less	19	32	29 or less	4	3
Beef	6	6	15–29.99	22	26	30–49	54	42
Pig husbandry	5	3	30–49.99	23	19	50 or more	42	55
Poultry	1	1	50–74.99	17	12	*Total*	*100*	*100*
Other animal husbandry	3	5	75–99.99	9	6			
Cereals	43	44	100 or more	10	6			
Other special crops	6	6	*Total*	*100*	*100*			
Garden crops	5	3						
Other crops	8	13						
Other production	5	1						
Total	*100*	*100*						

The survey addressed topics related to the characteristics of the farm (location, line of production, share of different activities from the total turnover, farm size) and the farmer (farmer age), management factors (farm strategy, perceived needs for environmental management), adoption of farm subsidy measures, perceptions concerning the development of the farm performance and perceptions concerning development of the area as well activities in which the farm resides. In addition to the variables derived from survey data, an additional variable describing the biophysical environment of the farm was extracted from public statistics sources based on the farms' location.

3.2 Operationalisation strategy

The operationalisation strategy for resilience was based on two variables, which capture the farm development trajectories over the past three years (2007–2009) before the survey: the perceptions of environmental and economic performance. The statements were formulated accordingly: 'the activity has developed to be more environmentally-friendly', and 'the competitiveness of the activity has improved'. The response options were based on a five-point Likert scale with options ranging from 'does not represent at all' to 'represents very well'. The resilience of farms was captured by forming a typology of farms based on these two variables. The farms were divided into four distinct groups: the resilient farms, in which both the environmental and economic performance had evolved positively; the vulnerable farms, in which both types of performance had evolved negatively; and two types of partially vulnerable farms: the economically vulnerable farms, in which the environmental performance had evolved positively but economic performance negatively, and finally the environmentally vulnerable group in which economic performance had developed positively but environmental performance negatively.

As a whole, the operationalisation strategy accounts for four aspects of resilience, as discussed by Darnhofer et al. (2016) and Meuwissen et al. (2019): (1) the environmental dimension, as in accounting for the public goods the farm provides; (2) the economic dimension, as in accounting for the private goods of farming (*the structural approach to resilience*); (3) the mental model through which these constructs are filtered (*the agentic approach to resilience*); and finally (4) the temporal aspect accounting for the adaptability of the farm in time (*the relational approach to resilience*). Out of these, the two survey statements capture points (1) and (2), the reference to farmer's own judgement captures point (3) and the evaluation of the development trend captures point (4).

3.3 Independent variables

Given the exploratory nature of the initial survey, the variables the role of which in contributing to farm resilience was analysed were not strictly derived from a theoretical resilience framework, but rather reflected the factors that centrally contribute to farms' performance at a general level. Thus, the process of selecting the variables for the statistical model did not follow a line of deductive reasoning within a theoretical framework, but rather a data-driven, inductive approach was utilised in determining the relevance of those factors. The independent variables included in the statistical model were thus chosen in a pre-screening process based on cross-tabulations and analyses of covariance. To avoid multicollinearity, those variables that correlated with other explanatory variables were excluded from the analysis. Among the remaining independent variables to be included in the statistical models, no significant correlations were observed.

The independent variables that were used in the final models as predictors for farms' position within the resilience typology are described in more detail in the following section. The variables were grouped into two main categories: variables reflecting the external structure and variables reflecting farmers' agency. The rationale behind this categorisation is based on an interpretation of the factors that act mostly as conditioning farmers' decisions, and the factors that reflect farmers' interaction with and interpretation of the external structure (see Archer 1995). The descriptives of the studied variables are presented in table 2.

3.3.1 Structure as conditioning farmers' agency

The factors that were interpreted as structural factors that condition farmers' agency included the main line of production, farm size and the biophysical environment of the farm. *Main line of production* included originally 10 categories (see table 1), which were condensed into six categories in the stage of analysis: dairy and beef, pig and poultry, cereals, horticulture, other crops, and other cattle and other production. Within these, the most common main line of production was production of cereals (43%), followed by dairy and beef (25%). *Farm size* was measured by a categorical variable with six classes, the most common size category being 30–49 ha. The *biophysical production conditions* of the farm's location were described by the share of farmland of the total land area in the municipality where the farm is located. The larger the share of farmland, the more favourable the conditions are for agricultural production. Data for the agricultural area in each municipality was derived from the Economy Doctor service produced by the National Resources Institute Finland and the information concerning the total land area in each municipality was obtained from Statistics Finland. The farm's line of production and its size are in principle subject to farmers' decision-making, in that they could be changed (unlike the farm's location). However, they are also manifestations of strongly path-dependent farm development trajectories, transformation of which requires lots of activation energy, and in this sense, they serve as good examples of structuration processes (Giddens 1984) – what is the result of active agency at some point of time turns out as structure conditioning agency at a later point in time (Archer 1995).

3.3.2 Interaction and interpretation as manifesting farmers' agency

Interaction with the external structure and interpretation of it against the backdrop of the farmer's experiences, expectations and worldviews is reflected in factors manifesting farmers' agency. Factors depicting the interaction of farmers with the external structure include the management strategy of the farm, type of farming (organic/conventional) and adoption of special agri-environmental measures. *The farm strategy* was operationalised by asking the respondents to choose one of the five options describing best the development of their farm between 2007 and 2009: growth, diversification, no change, downsizing or closure. Business as usual ("no change") was the most common strategy (60%), followed by a growth strategy (19%). *Special AEMs* included measures related to the protection of waterways (riparian zones, multifunctional wetlands), extensification (arable farming in groundwater areas, focused reduction of nutrient loading, permanent grasslands on organic lands), changes in production techniques (incorporation of liquid manure into the soil, runoff water treatment methods) and promotion of biodiversity (traditional rural biotopes, enhancing the biological and landscape diversity of agricultural environments, local breeds and crops) (MAF 2011a). The adoption rate of special AEMs was 37%, and they were considered as a single dummy variable (adopted/not adopted). *Organic farming* also classifies as a special agri-environmental measure within the reviewed agri-environmental scheme, but it was treated as a separate variable in this study. Organic producers had a share of 9% in the dataset. Both organic farming and other special AEMs were adopted slightly more often in the survey sample than among the base population (MAF 2011b). Less Favored Area (LFA) payments and basic AEMs were not considered in this analysis because of their high adoption rates among respondents (96% of respondents received LFA payments and 97% received basic agri-environmental payments). The high adoption rates derive from the LFA status of the whole Finland and from the exceptionally high level of popularity of the AEMs in Finland. That is why in the Finnish context the special AEMs with more targeted goals and limited adoption are of special interest, as compared with the basic measures.

Factors depicting interpretation of the external structure include farmers' age, perceived environmental vulnerability of the farm environment and perceptions of social capital. The *farmers' age* was measured by a categorical variable with three classes, the most common age group being 30–49 years. The *perceived environmental vulnerability* was measured separately for five items: soils, waterways, biodiversity, air quality and landscapes. For each of these items, the respondents were asked to evaluate the need for environmental management or the level of environmental risks on their own farm, depending on the topic. The responses were given on a categorical scale ranging from 1 (no need for environmental management or no risks) to 5 (very significant need for environmental management or high risk). The five farm-specific needs for the environmental management were all statistically significantly intercorrelated (0.420–0.663). For the analysis, the needs for environmental management were therefore converted into a single variable by taking the average of all five items (Cronbach's alpha 0.837). The impact of *social capital* was captured by two separate variables. The first variable described the socioeconomic development of the farm's location municipality. This socioeconomic development was captured by six statements, the response options of which were based on a five-point Likert scale ranging from 'does not represent at all' to 'represents very well'. The topics of the statements are presented in table 2. The second variable described the farmers' perceptions regarding the implementation of the administrative process of agricultural policies. These views were captured by five statements concerning partnership, trust, mutual interest and administrative burden. The response options were given on a five-point Likert scale ranging from 'completely disagree' to 'completely agree'. For both constructs, an average value of the statements was used as an independent variable (Cronbach's alpha value for the sociocultural development was 0.897 and for the perception of the administrative process 0.806).

Table 2. Research variables and their descriptives.

Variable	%	Average	Std. dev.
Farm resilience			
Improvement of environmental performance (scale 1–5)		3.41	0.83
Improvement of economic performance (scale 1–5)		2.38	1.03
Structural factors			
Main line of production (% of farms)			
- Dairy and beef	24.6		
- Pig and poultry	6.1		
- Cereals	43.0		
- Horticulture	10.5		
- Other crops	8.2		
- Other cattle and other production	7.5		
Farm size (ha, % of farms)			
- 14.99 or less	19.0		
- 15–29.99	21.7		
- 30–49.99	22.9		
- 50–74.99	17.3		
- 75–99.99	8.7		
- 100 or over	10.3		
Average share of agricultural land in the municipality area (%)		18.49	10.90
Agency factors			
Age of the farmer (years; % of farms)			
- 29 or younger	4.4		
- 30–49	53.9		
- 50 or older	41.7		
Strategy (% of farms)			
- Growth	19.5		
- Diversification	10.3		
- No change	59.7		
- Downsizing	10.0		
- Closure	0.6		
Organic farmers (% of farms)	9.1		
Adoption of special AEMs (% of farms)	36.9		
Perceived needs for environmental management (scale 1–5)			
- Soil		1.92	0.94
- Waterways		2.53	1.06
- Biodiversity		2.52	1.04
- Air quality		1.79	0.89
- Landscape		2.54	1.09
- *Combined indicator value*		2.26	0.79
Social capital: Perception of socioeconomic development (scale 1–5)			
- Diversification of the economy in the area		2.37	0.85
- Sense of solidarity among the local residents		2.35	0.80
- Regional development activities		2.38	0.80
- Marginalisation present in the area		2.27	0.80
- Improvement of the attractiveness of the area		2.44	0.90
- Improvement of the atmosphere of the area		2.40	0.80
- *Combined indicator value*		2.37	0.65
Social capital: Perception of the administrative process (scale 1–5)			
- Administrative burden		2.96	1.14
- Comprehension of the administrative process		3.15	1.10
- Partnership with the administration		2.85	1.07
- Trust with the administration		2.97	1.09
- Interest of administration in the effectiveness of the subsidies		2.82	1.00
- *Combined indicator value*		2.95	0.81

3.4 Statistical model

To study the factors that differentiated the farms in terms of their resilience, multinomial logistic regression was utilised. The methodology of regression analysis is 'concerned with describing the relationships between a response variable and one or more explanatory variables' (Hosmer and Lemeshow 2000, 1). Thus, the method allows to depict the relationships of several independent, explanatory variables with one dependent variable (farms' resilience) in one model. Logistic regression instead of linear regression is plausible when the dependent variable is categorical and the independent variables are categorical or continuous. The analysis was carried out in two phases: first, comparing the vulnerable farm groups with the resilient farm group (model 1), and second, comparing the resilient farm group with all the other farms (model 2). This made it possible to determine the characteristics of each farm group in the data. In the first phase of the analysis, the resilient farm group was used as a reference category. In this phase, the analysis identified those factors that distinguished the vulnerable groups from the resilient group. In the second phase, the reference group was all the other farms within the data against the resilient group.

The regression function to be fitted in the data can be written in the following form:

$$\mathrm{logit}(p) = \log(p/1-p)) = \beta_0 + \beta_i X_i;\ i = 1...n,$$

where p is the probability of a certain state of the dependent variable, β_0 is the constant term (intercept), and β_i is the set of parameters (regression coefficients) for the set of the independent variables (X_i) (Hosmer and Lemeshow 2000). The model was estimated using the maximum likelihood method and the statistical significance of the coefficients was evaluated using Wald statistics. The results are given as regression coefficients (β). In determining the reference groups for the categorical variables in the analysis (i.e. the factors), cross-tabulations were conducted before running the models. The analyses were conducted using IBM SPSS Statistics software.

4 Results

In this chapter, I will first present the results of the resilience typology in chapter 4.1, and second, the results of the statistical models detailing the factors that characterise the farms in the resilience typology in chapter 4.2.

4.1 The resilience of Finnish farms

The resilience of farms was operationalised along two dimensions: the development of economic and environmental performances of the farm. The environmental performance was generally perceived to have improved more often than the economic performance was, with the average value of 3.41 (corresponding with 'represents moderately') for environmental performance and 2.38 (corresponding with 'represents poorly') for economic performance, respectively. Environmental performance was perceived positively (moderate or good performance) by 90% of the respondents, whereas economic performance was perceived positively by 43% of the respondents. The distribution of the responses within these studied variables is presented in table 3. There was a positive and statistically significant correlation between farmers' perceptions of the development of environmental and economic performance, indicated by a Spearman correlation coefficient of 0.199 (significant at $p < 0.001$ level). The better the environmental performance was, the better the economic performance, and vice versa.

Table 3. Frequencies of the responses to the statements describing the development of the environmental and economic performance of the farms.

	Development of environmental performance		Development of economic performance	
Responses to statements	n	%	n	%
Does not represent at all	46	2	452	22
Represents poorly	165	8	741	36
Represents moderately	937	45	585	28
Represents well	771	37	256	12
Represents very well	172	8	48	2
Total	*2091*	*100*	*2082*	*100*

The respondents perceived the development of the environmental performance significantly more positively than they did economic performance, with a difference of one Likert category response unit in the average values of the performance perceptions. Accordingly, the category limits for the resilience typology were set differently for environmental and economic performance. In the case of environmental performance, poor performance (Likert categories 1–2) was merged with moderate performance (Likert category 3) to form the vulnerable group, and the positive performance (Likert categories 4–5) formed the resilient group. However, in the case of economic performance, the middle category was combined with the resilient group (Likert categories 3–5) and the poor performers (Likert categories 1–2) formed the vulnerable group. The resulting balanced typology depicting the resilience of farm systems is presented in table 4. Drawing from this typology, minority of farms (23%) were classified as resilient, with good environmental performance and moderate to good economic performance. The largest share of farmers (36%) were situated in the vulnerable group with poor to moderate environmental performance and poor economic performance. Around 20% of farmers were in both of the partly vulnerable groups.

Table 4. Typology of farm system resilience and number of farms in each group.

	Environmental performance				
Economic performance	1 – Very poor performance	2 – Poor performance	3 – Moderate performance	4 – Good performance	5 – Very good performance
1 – Very poor performance 2 – Poor performance	**Vulnerable group** n = 738 36%			**Economically vulnerable group** with good environmental and poor economic performance n = 452 21%	
3 – Moderate performance 4 – Good performance 5 – Very good performance	**Environmentally vulnerable group** with poor/moderate environmental and good economic performance n = 400 19%			**Resilient group** n = 483 23%	

4.2 Factors contributing to the resilience of Finnish farms

The results of the regression analyses are presented in table 5, including the regression coefficients (B) and significance levels. The sign of the regression coefficient identifies the direction of the effect the variable has in relation to the reference group. The results of the first model identify the variables that characterize the vulnerable groups in relation to the resilient group, while the results from the second model identify the characteristics of the resilient group in relation to all the other farms. Both models are statistically significant.

The *vulnerable farm group* was the largest group with 738 farms (36%). Vulnerable farms were likely to be small. Regarding the line of production, this group was characterised by cereal production and pig and poultry production ($p < 0.1$). The market situation of cereals was difficult around the time the survey was conducted (Niemi and Ahlstedt 2010), thus, the effect of line of production may reflect the volatility of these farms towards price shocks. These farms were typically farmed by young farmers. The farmers in the vulnerable group had not committed to farm development and they had not adopted special agri-environmental measures. They also had negative perceptions of both the local socioeconomic development and the administrative processes related to the implementation of agricultural policies and the agricultural support system.

The *economically vulnerable farm group* consisted of 452 farms (21%). The farms in this group were likely small in size and farmed by old farmers. Regarding the line of production, other cattle and other production was the least likely to rank within this group, with the only statistically significant relationship found in this variable. These farmers had not committed to developing the farm but were the most likely to downsize their farming business. They were not likely to be organic farmers but paid attention to environmental issues manifested by farm-level needs for environmental management, which they perceived higher than others ($p < 0.1$). These economically vulnerable but environmentally resilient farms thus indicated a concern for environmental issues at the farm, while the economic aspects suggest that these farms were about to leave the stage, indicated by the intentions related to downsizing and older age of the farmers. Farmers in this group also held negative perceptions of the local socioeconomic development and administrative processes.

The *environmentally vulnerable farm group* included 400 farms (19%). This environmentally vulnerable but economically resilient group was the smallest group within the typology, and in this group, the smallest number of statistically significant relationships was found. These farms were most likely of average size, thus neither large nor small. The farmers had not committed to farm development (but were not downsizing either; $p < 0.1$), and thus held a business-as-usual orientation. These farmers held negative perceptions of the local socio-economic development.

The *resilient farm group* consisted of 483 farms (23%). This was the only group characterised by large farm size, while the other variable indicating the conditioning effect of external structure, line of production, did not play a major role. The resilient group was also the only group characterised by commitment to farm development strategies in terms of either growth or diversification. The farmers were likely to have adopted special agri-environmental measures ($p < 0.1$), which suggests that perceptions of environmental performance were grounded in these farmers' actual management decisions to work for environmental issues at the farm. Social capital supported the observed resilience: the resilient group was the only group in which farmers held positive perceptions about the local socioeconomic development and administrative process.

The observed characteristics of resilient farms formed a striking contrast with vulnerable farms especially in terms of farmer agency. The resilient farms were the only group characterised by adoption of development-oriented strategies instead of business-as-usual or downsizing, positive perceptions of social capital, and the adoption of special agri-environmental measures. However, farm structure also made a difference: large farms were far more likely to be resilient in comparison with small farms. The opposite was true for the vulnerable farms, which were of small or average size. Factors depicting farmers' agency had statistically significant relationships with the vulnerable groups, but predominantly in the negative direction: for the most part, vulnerable farms did not indicate possession of positive agentic capabilities.

It could be argued that operationalising resilience in this way actually arises from the farmers' perceptual tendencies – the same farmers found their environmental and economic performances improved and seemed to possess social capital both in relation to the local social environment as well as towards the administration. However, it is important to note that perceptions concerning social capital only affected farmers' ranking within the resilience typology when both environmental *and* economic performance had improved. In all the other cases – also in those cases where farmers were resilient in either but not both of these dimensions – the relationship with factors depicting social capital was negative. Thus, while the perceptual tendencies undoubtedly are real, they at the same time seem to reproduce farm-level resilience, as well as being given rise to by structural conditions that enable resilience, most importantly large size of the farm. The size of farm holdings is one of the most important factors that guarantees for example access to capital, and thus allows investments. Apart from cereal production and pig and poultry production, which were linked to vulnerability, the line of production did not place decisive structural constraints on resilience. The same goes for the biophysical production conditions; even though initial screening suggested covariance, this factor was not related to farms' resilience in the final analyses. The role of structure worked in different directions for resilient and vulnerable farms: resilience was enabled by especially large farm size, while the small size along with specific production activities placed constraints on resilience at the vulnerable end.

In all, both the structure and agency matter for resilience: the structural factors as either enabling or constraining farmers' agency, and agency as making interpretation of the structures and interacting with them. When farmers' agency is manifested in interaction, it can take the forms of strategic decision-making as in the case of the farms' development strategies or making use of the available policy measures as in the case of adoption of special AEMs or organic farming. When it is manifested in interpretation, it relates to the farmers’ perceptions concerning the environment (as in perceived needs for environmental management) or to the socio-cultural environment (as in the perceptions concerning the social capital). It is obvious that there are numerous other factors that could and will contribute to farm-level resilience that were not included in this survey but merit further research – such as issues related to trade channels, nutrient balances, off-farm working, attitudes and values, knowledge etc. The findings do, however, indicate that farmers’ perceptual tendencies – their very agency – is central for resilience, but this resilience takes place in a specific context, which in this case was large farms.

Table 5. Results of the regression models.

	Model 1						Model 2	
	Vulnerable farms		Economically vulnerable farms		Environmentally vulnerable farms		Resilient farms	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
Intercept	4.266	0.000	2.149	0.000	1.541	0.005	-3.857	0.000
STRUCTURAL FACTORS								
Main line of production (reference: horticulture)								
Dairy and beef	-0.123	0.637	-0.446	0.100	-0.373	0.141	0.309	0.148
Pig and poultry	0.643	0.077	-0.189	0.647	0.285	0.418	-0.328	0.287
Cereals	0.614	0.012	0.303	0.221	-0.294	0.231	-0.209	0.299
Other crops	-0.383	0.238	-0.193	0.546	-0.526	0.120	0.385	0.145
Other cattle and other production	-0.262	0.438	-0.78	0.031	0.062	0.840	0.269	0.311
Farm size (reference: largest size group, > 100 ha)								
< 15 ha	0.638	0.029	0.564	0.071	-0.179	0.556	-0.348	0.148
15–29 ha	0.673	0.012	0.584	0.045	0.356	0.182	-0.528	0.017
30–49 ha	0.783	0.002	0.711	0.011	0.509	0.038	-0.660	0.002
50–74 ha	0.359	0.173	0.587	0.037	-0.019	0.941	-0.273	0.191
75–99 ha	-0.091	0.759	-0.251	0.453	-0.284	0.328	0.223	0.346
Share of agricultural land	-0.003	0.687	-0.003	0.719	-0.004	0.618	0.002	0.671
AGENCY FACTORS								
Farmer age (reference: farmers aged 30–49)								
Under 30	0.717	0.034	0.043	0.918	0.038	0.909	-0.291	0.300
50 or older	0.213	0.146	0.329	0.033	-0.201	0.210	-0.116	0.358
Farm strategy (reference: business as usual)								
Growth	-1.528	0.000	-1.193	0.000	-0.168	0.335	0.909	0.000
Diversification	-2.278	0.000	-1.375	0,000	-0.48	0.022	1.306	0.000
Downsizing	0.260	0.337	0.792	0.004	-0.677	0.091	-0.362	0.147
Organic farming (reference: conventional)								
Organic farmers	-0.331	0.155	-0.518	0.039	-0.107	0.643	0.294	0.120
Special AEMs (reference: no adoption)								
Adopted special AEMs	-0.363	0.014	0.055	0.721	-0.246	0.109	0.213	0.084
Perceived needs for environmental management	-0.107	0.232	0.162	0.081	-0.081	0.387	0.019	0.796
Social capital								
Perception of local socioeconomic development	-1.142	0.000	-0.769	0.000	-0.362	0.002	0.751	0.000
Perception of the administrative process	-0.346	0.000	-0.275	0.003	-0.057	0.539	0.224	0.003
n	665		425		371		467	
Reference category	Resilient farms, n = 467						Vulnerable farms, n = 1461	
- 2 log likelihood	4639.977						1869.793	
Likelihood ratio	608.200, $p < 0.000$						264.987, $p < 0.000$	
Cox and Snell R^2	0.271						0.128	
Nagelkerke R^2	0.290						0.192	
McFadden R^2	0.116						0.124	

5 Discussion

In this study, my aim was to 1) describe the baseline of the resilience of Finnish farms: what kind of distribution of farms can be observed in a resilience-vulnerability typology; 2) explore the factors that contribute to this baseline in terms of structure and agency; and 3) discuss the implications of the findings in relation to the development dynamics of the Finnish agrifood system. The operationalisation strategy for resilience was built on the relationship between environment and economy: a resilient farm system performs well in both domains. The economic dimension represents the private function of farm systems (Meuwissen et al. 2019): farming as a source of income and viable business for the practitioner, the farmer. The environmental dimension then stands for ecological sustainability, in which the farming practices are aligned with the local environmental characteristics, and thus represents the public function of the farm system (Meuwissen et al. 2019). These development trajectories were captured through farmers' perceptions, with the presumption that the relevant information regarding resilience is condensed in the farmers' mindsets and understandings of the system they are embedded in. With such an operationalisation strategy, the majority of farms were deemed vulnerable in either or both of these dimensions. However, a general positive correlation between perceptions farmers held about their farms' development trajectories in these dimensions was found, suggesting that these functions are likely to coexist on farms. The literature that explicitly tracks the relationship of environmental and economic performance on farms using e.g. indicators derived from life cycle assessments credit this positive relationship to efficiency of production, which improves economic performance and reduces the amount of environmental pollution, resulting from e.g. excessive fertiliser use (e.g. Groot et al. 2006, Ondersteijn et al. 2003). While based on the data of this study it is impossible to infer e.g. farmers' fertilisation practices, a common denominator can be found in the farmers' development orientation.

Strategic orientation plays an important role in reproducing farm resilience (Darnhofer 2010, de Roest et al. 2018). In this study, a development trajectory related to either growth or diversification was unlikely to be found among vulnerable farm groups, while it solely characterised the resilient group. The tendency for alignment of environmental and economic performance trajectories can be seen as an impact resulting from this development orientation. While such an orientation can lead to more effective farm management, an orientation towards farm development and the future generally has been found to positively affect farmers' decisions to adopt environmentally friendly farming practices (Morgan et al. 2015, Peltomaa 2015), while pessimistic perceptions and orientations act in an opposite way (Wilson et al. 2013). The results of this study suggest that resilience of Finnish farms was more related to adaptability or transformability type of resilience than perseverance, indicated on one hand by the change-oriented development strategies on resilient farms and on the other, the vulnerability of farms that aimed at practicing business-as-usual.

Farm resilience can be seen as a manifestation of several factors reflecting farmers' agency, both in terms of the interpretations they make as well as actions they take. The farmers in the resilient farm group were able to benefit from the policy measures available, to lean on social capital and to aim for constant development of the farm system. These traits are likely to work in reciprocal relationships, reinforcing each other, as has been found in the case of farmers' development intentions and their proactiveness in social networks (Hansson and Ferguson 2011, Methorst et al. 2017) and social capital and adoption of agri-environmental measures (Allo et al. 2015). Social capital in itself has been seen as a central element contributing to resilience or even being a part of it (Adger 2003), and the strong relationship found here indicates to this direction as well. One specific type of social capital measured in this study was related to the relationship with the administration and perceptions of the administrative processes. Positive perceptions of and relationships with the administration can enhance sustainable management practices (Hall and Pretty 2008, Kaljonen 2006), which can also enhance the resilience of farms in enabling them to benefit from the policy measures available (Ashkenazy et al. 2018). The interrelatedness of these aspects of agency contributing to farm resilience indicates the existence of a virtuous cycle with self-reinforcing feedback loops (Gosnell et al. 2019). Such self-reinforcing feedback loops 'are found whenever a system element has the ability to reproduce itself or to grow as a constant fraction of itself' (Meadows 2008, 31).

Yet the resilience (and vulnerability, respectively) of farms was conditioned by the external structure, most importantly farm size. Farm size is one of the most important structural factors manifesting the adaptation of the farms to their current operational environment, which allows farms to 'exploit current strengths and focus on efficiency' (Darnhofer et al. 2010a, 192). Large farms are able to benefit from economies of scale in a regime characterised by low and volatile farm incomes (de Roest et al. 2018), and they are more likely to possess slack resources enabling development activities than small farms are (Baumgart-Getz et al. 2012). The starting point for a virtuous cycle is most likely to be the result of a combination of farmers' agency and the farm structure. Emery and Flora (2006) describe in their community capitals framework how the interaction of various forms of capitals, such as social, natural, human and financial capitals, yields spiralling effects both upwards and downwards. While the upward spiral characterised the resilient farms, the downward spiral could be observed in the case of vulnerable farms, when farmers on these farms perceived their environment negatively, were confined to business-as-usual or even downsizing strategies, did not opt into special agri-environmental schemes etc.

The effect of structural factors, and especially farm size, is derived from the larger agrifood context: when the agrifood system is progressing from the exploitation phase towards the conservation phase in the adaptive cycle, the centralisation within the system increases throughout the systemic scales, including the farm systems. During the exploitation phase in the adaptive renewal cycle, the regime grows more robust, homogeneous and productive. For farms, these developments imply a tightening cost-price squeeze and increased volatility for price shocks (Lamine 2014, van der Ploeg 2017). Large farms are usually best equipped to meet these challenges. The effect of the other structural factor, line of production, indicates the market volatility cascading through the agrifood system, but the effect on resilience was not as strong as the effect of farm size. Diversity has been seen as an important feature of farm resilience, while specialisation can increase vulnerability in the long term, even though it is a profitable option in the short term especially during the conservation phase (Darnhofer et al. 2010b). The resilient farms in this study utilised both strategies of specialisation through aiming at economies of scale and diversification through aiming at economies of scope.

For the resilience of farm systems, boosting virtuous cycles of farm development thus seems to be a critical task. Yet the resilience of farms does not simply arise from positive thinking and trusting that in the future things will turn out well. The systems need to be tuned into enabling such mindsets. As expressed by the majority of farms being vulnerable rather than resilient, and these farms being affected by things they cannot influence such as the prices of agricultural products, it is entirely possible that the leverage point for a virtuous, self-reinforcing cycle lies in the structures, and not in the farmers' mindsets or in their agency. It is possible that vulnerable farms have found themselves within a self-reinforcing cycle similar to that of the resilient farms, but one that is vicious. Darnhofer et al. (2016) point to the pitfalls of the normative use of the resilience concept in describing strategies to achieve resilience within the neoliberal agricultural regime, which are evident when interpreting the results of this study as well. My point is not to elaborate on how farms could be more resilient if the farmers would simply utilise the available policy measures, trust each other and aim for constant farm development. Rather, the results indicate that resilience demands alignment of structure and agency – a project that is not getting easier from the farmers' point of view, with the regime proceeding towards the conservation phase and simultaneously limiting farmers' room of manoeuvre.

The findings of the study bear some limitations as well as merit some avenues for future research. First of all, there is a need to connect the perceptual world of farmers to indicators depicting the dimensions of environmental and economic performance. While the results of this study suggested that the environmental perceptions are related to at least some environmental management decisions, this link deserves much further scrutiny. Second, exploration of the agency-structure constellations in the farm system context is necessary to understand this reciprocal relationship better. The list of variables included in the survey used in this study were by no means exhaustive, and further research could identify a wider set of structural factors affecting farm-level resilience. The extant literature on farm resilience has widely explored the universal capabilities of buffering, adapting and transforming enhancing resilience, but connecting these findings more strongly to analyses of the characteristics of the dominant agrifood regime could yield interesting insights.

6 Conclusions

Resilience within farm systems was the result of a self-reinforcing feedback loop created by the fit between the material structure of the farm with that of the agrifood system, coupled with farmers' agency in making use of the available resources. In practice this means that resilience was a property of large farms that were developed in terms of either specialisation or diversification, the farmers of which possess high levels of social capital and opted into special-level agri-environmental schemes. In contrast, vulnerable farms tended to be smaller farms with no development intentions, suffering from market volatilities and not manifesting possession of social capital. The observed resilience of Finnish farms in 2010 was characterised more by adaptability than by perseverance. This is due to the characteristics of the dominant neoliberal agrifood regime: in progressing from exploitation phase towards conservation in terms of the adaptive cycle, it is inflicting ever-growing pressures of increasing productivity on farms. This cost-price squeeze leads to centralisation processes penetrating all levels of the system, including the farm systems, and explains the confinement of resilience to large farms. In this light, the current crises of low agricultural profitability in Finland seems to be a natural continuum for a development that was observable among farms already in 2010. Thus, for farm resilience, it is not so much about what a farmer can do to enhance their resilience (Darnhofer et al. 2016), but about under which conditions a farmer can do anything to enhance it.

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