Towards a Deeper Understanding of Agricultural Production Systems in Sweden – Linking Farmer's Logics with Environmental Consequences and the Landscape

Rural Landscapes

RESEARCH

STOCKHOLM UNIVERSITY PRESS

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ABSTRACT

Farm restructuring is a continuous on-going process supported by national agricultural policy in Sweden; while striving for more efficient farms in terms of labor and yields, farms enlarge their holdings of arable land and animals. The environmental consequences of more intensive land uses have in turn stimulated environmental policies to deal with negative environmental consequences. In this paper we argue that an underlying problem with both of these policy approaches is that they primarily emphasize specific components of farms and fail to see the farm as an interconnected system. In this paper we therefore focus on the farm as a 'system' and on the systemic role of farming in the broader landscape. We develop a theoretical framework of farming logics which help to better understand agricultural production systems. Drawing on 34 semi-structured interviews with farmers, we divide the farms into three farming logic categories: I) 'production vanguards'; II) 'landscape stewards'; and III) 'environmental vanguards'. We use these categories to analyze the role of key aspects such as size, intensity of production, specialisation, how farmer preferences and knowledge influence land use systems, and interactions of these with the local landscape. The findings show how farms that on the one hand share some basic characteristics can display quite different farming logics and vice versa. We argue that these farming logics offer a potentially positive diversity in farming approaches, with complementary and mutually dependent roles in Sweden's overall food system.

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KEYWORDS:
farm restructuring; agroecology; land use; vanguards; production; environmental goal conflicts

TO CITE THIS ARTICLE:
Marquardt, K., Eriksson, C., & Kuns, B. (2022). Towards a Deeper Understanding of Agricultural Production Systems in Sweden – Linking Farmer's Logics with Environmental Consequences and the Landscape. *Rural Landscapes: Society, Environment, History,* 9(1): 1, 1–15. DOI: *https://doi.org/10.16993/rl.78*

INTRODUCTION

A central challenge facing agriculture is how to reliably generate sufficient food (as well as fodder, fiber, and energy) from farmland while simultaneously mitigating the environmental impacts of farming. In Sweden two principle lines of policy deal with this challenge. One is for continued farm restructuring to further improve farm 'competitiveness', that is, increased scale of production leading to greater volumes of production from a smaller amount of land at a lower cost. There is a long history of encouraging farm restructuring in Sweden, leading to increased average farm size and spatial differentiation. This restructuring has generated highly efficient farms in term of labour and yields, which produce large volumes of crops, but with negative consequences for the environment and landscape biodiversity. A proposal to allow corporate farmland ownership, something which so far has not been allowed in Sweden, was made in a official inquiry in 2015 (SOU, 2015: 15). The second strategy can be seen in various efforts to 'green' Common Agricultural Policy (CAP), that is, increasing environmental regulation of farming and building incentives through agri-environment schemes (AES) in order to mitigate negative climate and environmental impacts. The greening of the CAP started out as relatively moderate demands on farmers, but the long-term trajectory of CAP seems to indicate a strengthening of 'greening' efforts (Collantes, 2020) even if there remains some skepticism about this (Nelson, 2020).

The problem with both of these policy approaches we argue is that they emphasize only specific farm components or aspects, thereby simplifying complex farm settings and failing to see the farm as an interconnected system. For example, the agenda of restructuring farms for competitiveness primarily emphasizes labor efficiency, and to a lesser degree, yield, while largly ignoring other components that affect the environment negatively and are literally thought of as 'externalities'. While coming at this from a different angle, the 'greening' agenda, embodied in CAP-financed AES, focuses on a checklist of conservation related metrics (Öhlund et al., 2015) that, while certainly important, has a similar effect of lifting out only certain components of the farm, but again failing to see the whole system or the farmer as an autonomous actor (Burton et al., 2008). As Eksvärd and Marquardt (2018) have shown, strict adherence on the part of regulatory authorities to AES-related conservation metrics has occasionally had the perverse effect of forcing some farmers to cease their own efforts to improve biodiversity on the farm. Meanwhile – as we will demonstrate below – farmers, even those who have restructured to emphasize efficiency, see their farms as an integrated system. Furthermore, as we will show, the view of farming as an integrated system from the farmer point of view leads to alternative viewpoints about agriculture's production and environmental challenges. Such alternative solutions serve as an interesting counterpoint to the compartmentalised view of farming in the policy agendas mentioned above.

We will therefore focus in this article on the farm as a system and on the systemic role of farming in the broader landscape, and what and how farmers think about these. This means that we will bring attention to the close interconnectedness between the the local ecology and farmers' pratices and also link to the broader political-economic contexts within which farmers operate. The landscape perspective is important, as landscape elements are part of the production system on a farm. For example, open plain landscapes set different conditions for farming compared to mosacic forest landscapes, at the same time that the farming affects and 'creates' the landscape (Olsson and Berg, 2008). However, the relations between landscapes and farming systems are not, as this paper will show, always straight forward.

Further, contextual factors, such as market conditions and regulatory regimes also clearly impact farm development. Putting these together, farm systemic aspects such as practices of animal keeping, grazing and feeding regimes, land use practices, landscape configurations, local ecologies, crops choices, machinery, and on-farm labour availability, plus contextual factors such as market conditions, and rules and regulations together shape what farmers perceive as their room for manouevre in making decisions about the future of their farms. Importantly, these factors do not determine everything. Different farmers can look at the same or similar system and contextual factors and arrive at different conclusions for what is the best course of action, based on their own personal interests, values, and histories. We argue that the combination of the farmers' personal interests and histories, what can be called farming visions, and how they seek to develop their farms in relation to their farming system and the broader context, together defined by the various factors mentioned above, constitute a *farming logic*. As we will show below, farms that on the surface can look quite similar can be driven by a different logic of development, while farms that appear different can be driven by a similar logic.

This paper offers a detailed examination of three different farming logics observed in Uppland in Sweden: the farmers' vision and thinking on farm management and the production system and where they see their room for manoeuvre and change. In so doing, we examine the inherent contradictions and trade-offs between the relations of farm size, landscape and land use, yield efficiency, and environmental sustainability. We will explore the following research questions: (I) How can we understand farmers' different farming logics from an interconnected farm system perspective? (II) Where do these different farmers see the production and environmental conflicts in their respective farm systems? (III) What possibilities do they consider for overcoming or mitigating these conflicts?

BACKGROUND: SWEDISH AGRARIAN STRUCTURE

Swedish agriculture policies have had a strong focus on farm restructuring, justifying increasing farm size on the grounds of competitiveness. The assumption has been that farms will become more efficient through economies of scale (Flygare and Isacson, 2003). As a result, the top 10% of farms in terms of size now manage 50% of Swedish arable land (SCB, 2014: 51).[1] This has resulted in production specialisation, with large farms producing one or few key products such as milk, egg, meat, or grain. This has led to more uniform production landscapes, with negative consequences for biodiversity (Waldenström, 2018). But there are also many very small farms and almost 75% of all Swedish farms have less then 50 hectares of arable land (SCB, 2020: 39).

Though the farm sizes in Sweden have been increasing rapidly, it has not seen the development of the mega large farms managed by a corporate farming sector, as seen elsewhere in the Global North, such as Eastern Europe (Kuns et al., 2016), and North America (Ashwood et al., 2020; Magnan, 2011). At present the Swedish Land Acquisition Act, prevents legal entities (e.g., agribusiness corporations) from owning agricultural land. However in 2015, an official inquiry (SOU, 2015: 15) proposed allowing corporate ownership of farmland arguing that corporate entities would be able to finance larger and more capital intensive farms. This proposal met much resistance from Swedish farmers, who questioned the consequenses of such a proposal for family farms and the environment (Slätmo, 2017). While the proposal was not taken up by policy makers, it was mentioned again in 2017 in the first national food strategy (Prop. 2016/17: 104), indicating that the issue remains on the policy agenda. The potential effects of such a policy change would likely serve to continue restructuring Swedish agriculture and increase capital intensity and scale of production.

While corporate ownership of farmland remains forbidden, there is a unique actor in the area studied in this paper that not only in some respects resembles a corporate landowner, but that, as will be shown below, plays an important role in shaping the development trajectory of local family farms. This is the Uppsala University Foundation's Management of Estates and Funds (*Uppsala Akademiförvaltning*), hereon referred to as the Uppsala University Foundation or simply 'the Foundation'. The Foundation is a trust company that dates back to 1640. It owns 14,000 ha of farmland and forest, making it one of largest land owners in Sweden. Because the Foundation predates the Land Acquisition Act, it is exempted from the current ban on corporate ownership of land. It is not allowed to expand its land holding, but the foundation can buy and sell land as long as its total land holding does not increase. It is important to note that the Foundation does not farm itself but leases its land out to tenant farmers. In the discussion, we explore what the Foundation means for the prospects of corporatisation in Swedish agriculture.

THEORETICAL FRAMEWORK: FARMING LOGICS

In this section, we address several different strands of literature to define, theoretically, what we mean by farming logics. Farming logics, as we conceive them here, are constituted by farmer visions situated within the farming system, which is in turn defined by the agro-climatic situation and landscape configuration of the farm, the local ecology, and the broader political-economic context. Farmer visions have been usefully explored through studying how farmers respond to variations of the question of 'what is a good farmer?' (Burton et al., 2008; Sutherland, 2013), the answer to which plays a significant role in shaping both overall production orientation, that is, conventional or organic, and specific farm practices. Notions about the farming landscape, and how it should look, are also important aspects in cementing attitudes on 'good farmer' practice (Burton et al., 2008). In recent years, we have seen evidence that ideas and identities connected to a 'good farm' have been fragmenting around Europe (Sutherland, 2013), including Sweden (Saunders, 2016), meaning there is a shift underway from a dominant culture of productivism, that is, a good farm is a highly efficient farm in terms of yield and labor, towards a greater variety of farmer visions. One of the more prominent new visions relates to the environmental concerns that motivate many organic farmers. There are also new syntheses developing between different visions, which for example contribute to the well-known phenomenon of the conventionalization of organic (Chongtham et al., 2017; Darnhofer et al., 2011). The reverse tendency has also been seen, which has provocatively been called 'organification' of conventional (Rosin and Campbell, 2009, cited in Sutherland, 2013: 430), that is, conventional farmers adopting practices associated with organic farming or agro-ecology. With the material presented below, we will exemplify these tendencies, where a convergence in practices among conventional and organic dairy operations can be seen, but also a shift in attitude among large scale grain producers towards greater concern for the environment.

Meanwhile, the importance of landscape, local ecology, and climate for farm management decision making are usefully explained in agro-ecology. Agro-ecology emphasizes a farm system perspective, which entails both a focus on ecological principles and biological cycles at the local level (Altieri et al., 2015; Gliessman & Engles, 2015), but also includes farm resources such as labor (van der Ploeg, 2020) and knowledge (Eksvärd et al., 2014). Taking such a perspective therefore means that we focus on the 'qualities' of the farms in this study and how these in turn affect the farm as a 'system' as well as how they shape the rural landscape. Some key farm system qualities can be understood from studying the production focus of a farm. With respect to livestock farms, for example, ruminants have the ability to transform grass into protein, which in turn have impacts on land, which are different from the impact of mono-gastric animals such as pork and poultry that feed on cereals. However, in today's intensively managed farm systems such a distinction is not that simple; most cows also consume cereal as concentrated feed, particularly on intensively run dairy farms. The imprint of farm systems on the landscape therefore also depends on the intensity of production. Another example of qualities that set the conditions for production could be the variation of soil quality, for example soil nutrients, levels of organic matter, and soil structure. These kinds of fundamental biophysical conditions in the system, and the tradeoffs in role/function between farm animals, farmland, and other components of a farm, are crucial when projecting future farm systems, and their potential for producing crops on different land types, with different sets of land use methods (see e.g., Belfrage et al., 2005; Waldenström, 2018; Wästfelt & Eriksson, 2017). Moreover, the highly variable nature of the agricultural landscape means that 'best-use', from a landscape perspective, is highly contextual. Understanding the production system in terms of both the agro-ecological trade-offs and the landscape factors helps to understand the room for manoeuvre that farmers have.

Policy regimes, price levels for agricultural commodities and for fodder and farm inputs, and how markets upstream and downstream from the farm are organized constitute contextual political economic factors that also shape farm development possibilities, particularly among larger farms. While such exogenous factors have explanatory power when considering agrarian structures as a whole (i.e., the distribution of different kinds and sizes of farms), they are relatively less salient when seeking to explain farm change at the level of the individual farmer. We find support for this position in recent results of van der Ploeg (2018), who, based on a comprehensive database with data on all farms in the Netherlands, found a diversity of farm development pathways in all farm size categories. He argued for the importance of motivations related to farmer agency, to explain this diversity instead of macro-structural factors: 'the richly chequered mosaic of contrasting developments can only be understood if we include agency, operating at the micro level, within the analysis' (Ibid.: 517). Thus within the same farm-size category, there are diverse motivations that steer decisions on production orientation, and the degree of intensification. We intend to show a similar diversity of motivations in Sweden.

To a certain degree the distinctions we want to make with respect to farming logic coincide with the categories developed in the classical Swedish farm typologies (Andersson and Lundquist, 2016; Djurfeldt and Gooch 2002; Djurfeldt and Waldenström, 1999). In this regard, we are studying farmers that belong to the categories that Djurfeldt & Waldenström (1999: 225) have labeled 'notional family farmers' – family farmers whose income comes soley or mostly from the farm, 'part time farmers' – family farmers with diversified income sources, and 'big farms dependent on hired labor'. However, our broader theoretical aim is to show that farms in the same sociological category can be motivated by quite different farming logics. Our framework also bears some resemblance to the notion of 'styles of farming' employed by van der Ploeg (2009: 137), with some crucial differences based on the specificity of Sweden and a tighter theorisation around the role of the landscape. However, like van der Ploeg, our framework will show that 'there is no single way (let alone one superior way) to produce a reasonable income and promising prospects [in agriculture]. There are many ways, each entailing their own specific coherence that can bear good results' (2009: 138). We would add, based on our research, they also entail different strategies for dealing with eivronmental challenges.

The farming logics concept as we will show, will allow us to unpack 'styles of farming', 'family farms' and what being a 'good farmer' means in practice (Burton et al., 2008; Sutherland, 2013). Moreover, farming logics help to understand how farmers think about the landscapes they are in, the agroecological conditions they face and tradeoffs between production and environmental challenges of agriculture.

METHOD AND DATA COLLECTION

The paper builds on two sets of interviews at farms located along a 70 km long transect in Uppland, Sweden. The transect was designed in a z-shape in order to capture the variety of agricultural landscapes found in the region (see ***Figure 1***). The transect starts in the flat agricultural plains outside Uppsala, where grain farming dominates, and continues into a mixed forest/farm landscape northwest of Uppsala, where agriculture is either less specialised, mixed, or abandoned. This selection allowed us to capture a diverging range of farms with varying natural conditions for farming and farmers with different perspectives on land use.

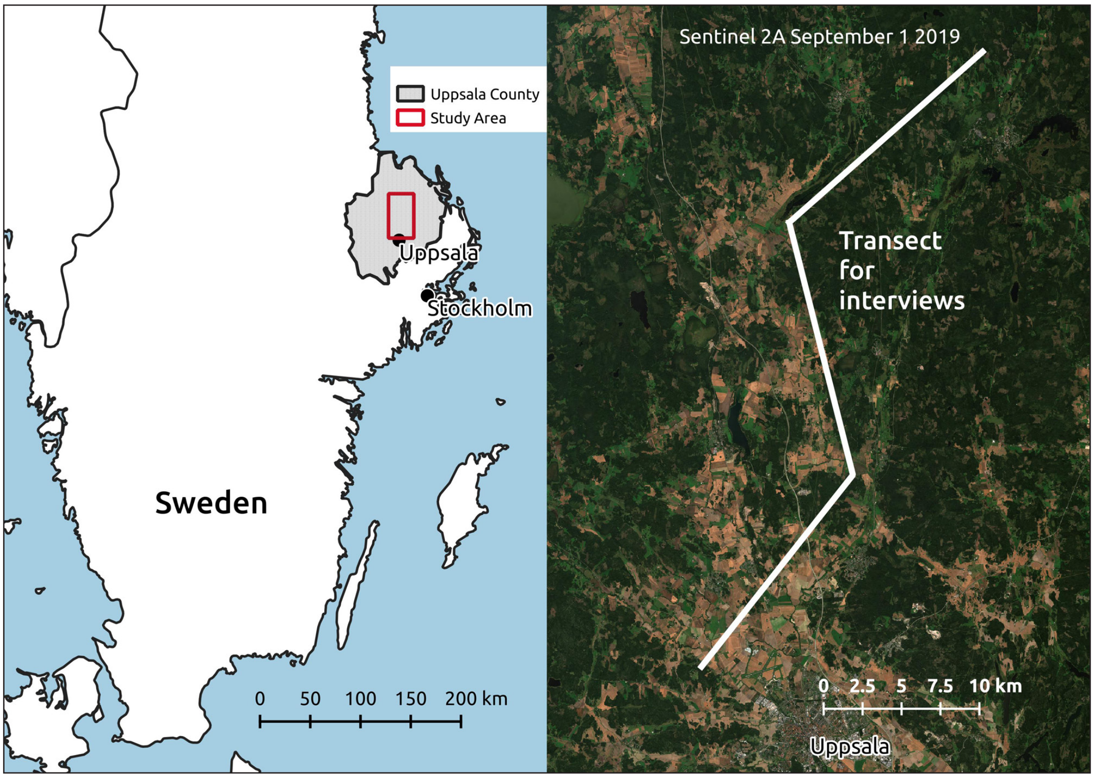

Figure 1 Map of case study area.

The first round of interviews (20 interviews made 2013 and 2014) were focused on the transformation underway in Swedish agriculture. We then went back to 14 of the farmers and conducted interviews focusing on how they conceptualised ecosystem services on their farms (in 2014).[2] The interviewees were between 23 to 70 years old, and the interviews were between one to two hours long and conducted in the farmer's house. We further conducted a key informant interview with a representative of the Uppsala University Foundation, the largest land owner and a key actor in the case study area. As will become clear, several of the large scale farmer in this study are tenants (sometimes over several generations) of the Foundation.

Interviewees were informed regarding their voluntary participation in the research projects within which the interviews were held. All the interviews were recorded with the interviewees' consent and notes were taken. In order to protect our informants' identities, we have taken care when revealing potentially sensitive information about events or other issues that could reveal their identities. Transcripts from the interviews have been analysed and coded thematically with a focus on the following themes: farm histories, farm management trajectories, land use, farm production, agricultural environmental aspects, labour, machinery, pluriactivity, decision-making strategies, and perceptions of threats and visions for the future.

Based on the interviews we have divided the interviewees into three 'ideal' farming logic categories. The notion of 'ideal' is a construction and reflection of an approximate reality through the selection and emphasis of specific features of land use and style and scale of production (Burger, 1976) and we have grouped them according to their 'vanguard expertise'. 'Vanguard' is a term inspired by van der Ploeg's (2009) work on specific excellences among different groups of farmer. Based on commonality in farming goals, practices, and land use, we have grouped farms into the 'ideal' farming logic categories according to what we regard as their prominent expertise. In reality there is of course divergence within the groups and interaction happening between the groups with both synergistic and antagonistic effects. Still, these analytical categories of 'ideal' farming logic categories help us to capture the role of key aspects of the farm system, such as size, intensity of production and specialisation, how farmer preferences and knowledge influence land use systems, and interactions of these with the local landscape.

The three 'ideal' farming logic categories are: 1) the 'production vanguards'; II) 'landscape stewardship'; and III) 'environmental vanguards'. The basis for the different categories consists of, as we will show, differences in farming objectives, practices and land use. In ***Table 1*** we have described the categories and ***Table 2*** shows the number of interviewed farmers and the kind of farm production for each category. Note that we have excluded two groups of land owners that are common in the case study area: hobby farmers and horse owners. We made this limitation because we wanted to focus the study on farmers that were active land users and get a substantial part of their income from their farming.

FARM LOGIC CATEGORIES	DESCRIPTION
I) Production vanguards	These are relatively large specialized farms (both conventional and organic) that are run as family-owned businesses with some employees. The farms have a high turnover, i.e., high costs for inputs that provide high yields of crops and animal products. Producers have deep knowledge of plant breeding and animal husbandry. They strive to optimize and streamline their farms in order to achieve good profitability in order to primarily create the conditions to support their family from the farm's production, at a level that corresponds to what wage work can generate. However, farms specialised on grain cropping often combine agriculture with other incomes. The logic of this category is directed at increasing high production levels.
II) Landscape stewards	Farms with primarily family farm labour and which have a clear identity as food producers. This group, unlike the previous group, often has a pronounced economic rationality based on less intensive production, which results in lower harvest/yield from the land and animals (low input/low output) compared to production vanguards. They argue, however, that such a production system yields an equally good net return as the previous group, because they take less financial risks, use less inputs and thereby have lower costs. They have a strong commitment as a stewards of the landscape and the agricultural heritage of the family. The logic of this category can be characterized as stewardship of the farm and the local farming landscape.
III) Environment vanguards	A group of farmers who see themselves as landscape caretakers and who see it as their task to develop new, more sustainable production systems. In this group, farmers are less driven by profitability and more by a strong commitment to the environment, and agriculture is seen as a platform for realizing ideas about a good life. Capital from other activities is brought into the farm, while the farming itself can have negative or zero economic results. Here the logic is characterized by a commitment to enviroinmental protection, as more important than production efficiency.

Table 1 Farming logic categories.

IDEAL FARMING LOGIC CATEGORIES	NO. OF FARMS	FARM SIZES (HA)	KIND OF FARM BUSINESSES	LAND TENURE ARRANGEMENTS	LAND USES
I) Production vanguards	5	200–800	3 specialised conventional grain farms, 1 organic grain farm with some livestock. 1 organic dairy farm. All have employees working in the farm and the other business activities.	3 farms rent all or main part of their land from Uppsala University Foundation. 2 own part of their land and lease remaining land areas from other private land owners.	For the conventional grain croppers basically all land is arable land. The organic grain cropper has 20% of the land as grass. The organic milk farm produces grass on crop land for their dairy cows, and have additional grazing areas used for younger animals.
II) Landscape stewards	9	90–200	6 conventional and 2 organic farms. 6 have mixed farms with grain and livestock (4 meat and 2 dairy). Family farm business combined with forestry, and off-farm employment and incomes.	All farms own some farm land. Additionally, they all lease land from neighbours (but not the Foundation).	Manage a mix of arable land and natural grazing areas (*naturbetesmarker*), meadows, flooded areas for fodder collection or grazing (*strandängar*), hey fields (*slåtteräng*).
III) Environment vanguards	3	8–180	3 organic farms; produce both grain and mixed livestock. On all farms the farm work is combined with off-farm employment and incomes.	Manage a mix of owned and leased land.	Same as above

Table 2 Farming logic categories, number of interviews, and farm management.

FINDINGS

THE PRODUCTION VANGUARD FARMING LOGIC

Even though production vanguard farmers tended to talk about themselves as 'tractor drivers' (F19) rather than 'real' farmers, the interviewees in this groups also talked about the joy they feel when they prepare the soil for sowing in the spring (F6) or to stand in a rapeseed field full of buzzing bees (F19). However, their work as farmers has quite a different character from smaller farms ('landscape stewards' and 'environmental vanguards'). The production vanguard are large scale producers and have a number of workers that they manage. They undertake detailed planning of the farm operations and they spend more and more time on the stock market, working with exchange transactions and futures contracts (F6, F8). As expressed by one farmer: 'In reality it is easier to earn money there (on the market) than in the cropping' (F8).

Size and landscape

The production vanguards are large-sized farms for a Swedish context, meaning between 200–800 ha of arable land. The category includes three conventional and one organic grain farm, and one organic dairy farm. The majority of these large sized farms are found on the highly productive plains, which facilitates large scale farm management solutions.

The farms of the production vanguards in the study have grown considerably in size during the last generation as a result of the farm restructuring. One farmer described how his land holdings have grown thirty times through his working life. Three out of the five of the farms in this category are run by tenants of Uppsala University Foundation and their growth has largely been pushed by the Foundation. In the interview with the Foundation, its representative argued that their efforts of increasing farm sizes was a need to strenghten the region's competiveness on the future global agricultural market and that their restruction secured the existence of regional agricultural production also in a long term perspective.

Farm expansion and large fields (F6 has fields larger than 100 ha) with long distances between the fields allow for less place specific adaptation to locality and conditions. Rather, all fields in one continuous cultivation area are planted with one crop (e.g., wheat), with the same variety, at a certain date, which is decided by logistics (where the machines are at that point). Thus most fields will be sowed (or sprayed or harvested) a bit too early or a bit too late from the standpoint of optimal agronomical practice.

The large conventional grain farmers emphasised that with a larger holding one has to be more engaged in details and be extremely careful concerning the logistics and thereby also the use of inputs compared to smaller producers. Investments in new technology are key for such control, such as GPS equipment that can direct the tractor driver not to give double doses of fertilisers or spraying in the overlap between rows and the turning areas. Such equipment also contributes to driving less on the fields, which in turn leads to less soil compaction damage.[3] An effective use of expensive technical investments is crucial. Two farmers (F6, F19), for example, stated that there are only 20–25 possible thresher days per year, making a large fast-working thresher central for their business.

All three large-sized conventional grain farmers stated that the larger the holding gets, the more complementary activities they need to develop and manage in parallel to the cropping, in order to keep the workers occupied during bad weather in summer or during the winter period such as forest management, carpentry, and house renting. Such incomes also smooth out income differences between good and bad cropping years. F11 pointed out that, as he had a lot of off-farm work, it was easier to be a conventional farmer. The ability to spray weeds gave him more flexibility in timing certain measures. This does not apply to the dairy farm in this category, as dairy production has more evenly distributed work over the year.

Land use strategies

The conventional large-sized grain farmers all have wheat as their main crop. Other crops such as primary rapeseed, but also peas are grown as 'break crops' as (some) rotation of crops is necessary. The break crops provide a fertilising effect on the following crop and also help control crop diseases.

All farms within the category used to have livestock on the farm until one to two generations ago, and they acknowledge that they still benefit from such historical nutrient stock in their soils ('we are farming old pig soils…'). The grain specialized vanguard farmers described soil fertility as a potential future problem. They stressed the need to close the nutrient cycle and they spoke of different strategies to conserve the nutrient stocks in their soils. In order to improve soil fertility, all three conventional grain farmers have switched to no-till field preparation.

> We don't have any animals or manure and one wants to economize with the little (organic) material (one has). […]. One gets a great humus content in the top 10 cm soil layer [after no-till field preparation]. (F8)

By using a cultivator, they scrape the top surface vegetation (in contrast to the plough that turns the soil around), a practice used for improving and maintaining organic matter in the soil which also saves time and fuel. Nevertheless, it does not give the same effect as animal manure which is described as 'outstanding' as a soil improver (F8). However, the increased weed burden, especially of root weeds, in no-till systems makes spraying of herbicides a routine treatment. This in turn makes no-till land preparation hard (if not impossible) to use in organic farming systems.

For the organic vanguard grain producer, ploughing along with crop rotation, was central to the control of weeds. This farmer said that there is a disconnect in that there are really good grain producers in Sweden but at the same time there is a shortage of organic cereals. He argued that the obstacles of converting a conventional crop production to an organic management is primarily a question of a mental barrier more than actual farming and profibility related issues. Reversing the usual argument, he said that to be a conventional farmer is more of a conviction than a sound business decision:

> You really have to be an idealist if you want to farm conventionally! […]. I mean, you might be able to get a twenty (percent) crop increase in organic (production) if you do things smart. […]. So there are bigger steps to take! (F11)

The dairy farmer in this category (F14) emphasized that manure has now become a resource, which is different from how it was viewed before. However, the idea of integrating animals as part of the overall farming system seemed quite distant to the large-sized conventional grain farmers. They instead looked towards the cities and stated that they wanted to use sludge as a soil improver on their lands. All three conventional farmers talked about what an unused nutrient resource sludge is and that society 'must' find a way for agriculture to integrate sludge into the farming system as a kind of manure. Another possibility to improve soil quality mentioned was to include grass in the crop rotation schemes ('with grass you can fix old mistakes', F19) with the idea to use it for biogas production. One of the grain farmers (F8) argued that the land use in future farming will be something in between todays conventional and organic farming.

For the organic dairy farmer (F11), grass production is the principal crop on the farm. To reach high milk production results, grass quality is critical and grass production on this farm takes place on arable land (i.e., not on traditional pastures or grazing land). The organic grain farmer planned to start up both egg production and acquire a limited number of cattle as a way to strengthen the cropping system (and partly as a way to increase the turnover).

Production and environmental goal conflicts

The interviewed conventional grain farmers were convinced that there are not any contradictions between production and environmental concerns in agriculture. They argued that they see themselves as environmentally friendly producers as they maximised production with an 'efficient' use of inputs (seven ton/ha of wheat is mentioned as a suitable level). The opposite would hold true for animal farmers, 'the cow manure is just heaved on and it leaks' (F19).

The grain producers regarded not exploiting the land to its full production potential as a misdirected environmental strategy:

> A good crop is healthy and grows and that is the best for the environment. A bad crop is the worst for the environment, because then it really effects it (negatively). (F19)

The organic grain cropper argued similarly that it is a productive use of land that legitimizes management methods:

> One should strive to reach almost the conventional (harvest) levels if one should justify organic production and that is possible, (at least) here and there. (F11)

The conventional grain producers pointed out that they are not against environmental directives in general, but that they would like to see other kinds of environmental measures, based on what they see as 'rational land uses'. Many current environmental rules they perceived as bureaucratic constraints, which miss their targets in complex settings and casue numerous trade-offs between advantages and risks. One issue that was highlighted in several of the interviews was the refusal on the part of the authorities to allow the removal of ditches and non-arable mid-field outcrops, something desired by the large-sized farmers in order to create larger and continuous fields. They argued such change would allow for more efficient use of their machinery, and help avoid spraying next to watercourses, and that they instead could undertake environmental measures in other areas (e.g., lay out a bug bank) where they regarded it would have a larger environmental impact:

> I think one should work more (with environmental work) on farm level, like; you do this (environmental negative action) – but then you have to do a phosphorus trap somewhere. (F8)

The production vanguards further thought that food production is so vital to society that it should have a different status and acceptance when it comes to thinking about its emissions and that regulations should instead be strengthened on other sectors (e.g., sewage water, flight travels).

THE LANDSCAPE STEWARD FARMING LOGIC

All interviewed farmers within this category took additional work outside the farm to be able to make a living. They emphasised how they didn't want to give up the use and management of their land. They wanted the traditional grazing land to be grazed and didn't agree with leaving arable land uncultivated.

Size and landscape

The landscape stewards in the study were found in mosaic landscapes on the edges of the plain or in hilly areas with mixed forest vegetation. These farms have between 90–200 ha of arable plus grazing land, as the majority combined crop production with keeping livestock, primarily cattle. Many of the respondents in this group lived on the farm their families have worked for generations, and they often refered to themselves as stewards of the landscape. None were tenants of the Foundation, and all owned their farms and leased additional land from other farmers.

All the farmers within this category were sceptical of the large-sized farms in the production vanguard category and they did not aspire to grow to such a size. However, some seek to grow a little more or at least continue to lease land as currently. These farmers complained about how the wealthy Foundation bought up all of the most productive land in the plains, pushing up land prices to a level that prevented them from expanding there. Thus despite not wanting to expand too much, a 'land hunger' still existed in the mixed forest landscape areas where the landscape stewards farms were located.

The mid-sized farms within this category have not made as large machine/technical investments as the production vanguards have. Instead they buy in services from machine entrepreneurs with highly specialized equipment for harvesting, spraying against insect pests and spreading liquid manure. Some of these farmers owned one specialised machine (e.g., sprayer) for work other farmers' fields as an extra income source.

Land use strategies

The landscape steward category contains both dedicated organic farmers and also conventional farmers who expressed concerns and doubts about organic farming as a system. What they have in common is how they express their management rationale in relation to landscape characteristics as a fundamental feature of the land use system and the feedbacks of farming practices:

> The cows are needed for the farming system. [...]. Keeping animals has given too little money. [...]. But anyway they are needed for the farm, to keep the land open. (F2)

Taking a landscape specific approach to land use differs from the homogenised land treatments practiced on the production vanguard farms. Landscape stewards tended to refer to production vanguards as 'calendar drivers' meaning that they do their farming operations, according to planned dates rather then when it is agronomically optimal. One farmer (F4) points out that the increasing farm sizes (among already large scale farmers) is only possible because of the cheap price of Round-Up. Round-Up is the herbicide sprayed in no-till management (see production vanguard farming category). He said that without Round-Up, the time to plough and prepare each hectare would be the double what it is now and thereby large scale grain cropping would be far less profitable.

Most of the landscape steward farms have livestock (for meat or milk) and the farmers described how they were 'animal people'. The respondents in this category (both those with and without livestock) describe the cows as the motor of their farm system through their feed (clover, grass) and manure. Their role of grazing the cultural landscape to keep it open and aesthetically beautiful was emphasised, and several respondents pointed out how rural areas gradually become impoverished as the animals disappear from the landscape.

> It is beautiful here, but that is thanks to the animals. (F2, F20, F21)

However, livestock production is hard to make profitable, and the farmers in this category said how they often feel squeezed by CAP rules and regulations concerning animals and land use, for which they receive agri-environmental payments, but which are nevertheless difficult to accomodate (see further Eksvärd and Marquardt, 2018). They described how neighbours have stopped keeping animals or farming because of complicated and rigid regulations.

In the interviews with this category of farm, there is much focus on the importance of understanding land use as integrated: crop rotation schemes; the quality of the soils, and the balance between crop and grass production and the number of livestock were reoccurring themes. As these kind of farms have livestock and produce grass, their crop rotation schemes are favourable from a soil nutrient and quality perspective. They use grass, clover seeds, peas, beans, and other crops as break crops in between their cereal harvests.

Among the conventional farmers there were some sceptical voices about organic farming, such as pointing out the weed burden on organic farms ('thistle growers' as expressed by F2, F20). Because the organic farms need to control their weeds by soil management methods, that is, ploughing, they use relatively higher level of fuel in comparison to the conventional growers, which has been seen as a paradox of organic production (Fess and Benedito, 2018).

The organic producers on the other hand hold an opposite position. They argue that the differences between the two production systems are narrowing, by which they meant that the prices and subsidies today make organic production profitable and that a skilled farmer can push the organic harvest levels upwards:

> If you look at modern milk production today, conventional and organic are not so far apart from each other in how to feed. The conventional ones have moved closer to the organic feeding system in recent years. They find that the cows are getting healthier, but are better off with more roughage and less concentrated feed. (F13)

Production and environmental goal conflicts

The debate between conventional and organic land use systems was present within the landscape steward category. However, as these farms all had livestock, manure was a central aspect of their environmental reasoning. One conventional farmer (F2) argued that the kind of organic farm that he thought actually could function well system-wise would be a dairy farm with liquid manure, which could thus use and distribute the nutrients in an efficient way. One respondent speculated that the overall landscape would benefit if the organic farmers could sell and spread their potasium and phosphurus rich manure to conventional farms and be allowed to purchase the nitrogen they lack. Then, he argued, the nutrients would be used better from a larger system perspective.

All the conventional farmers in the landscape steward group pointed out that although they spray their fields, this is not something they enjoy. They argued that they spray in a modest way, only when it is necessary (in difference to the 'calendar drivers') and often with lower doses than recommended as they don't like the spraying and it is expensive. One of the organic farmers in this category explained how the spraying was on one of the factors that had pushed him into converting to organic:

> I simply don't think chemicals and food goes together. [...] I would not go back to conventional (precisely) because of the chemicals. (F13)

THE ENVIRONMENTAL VANGUARDS

This group of farmers expressed a strong interest in carrying out a continuous farm development towards new and extended environmental objectives, which is the chief difference with organic farms in the steward category. All environmental vanguard farmers not only had ongoing environmental projects on their farms, they also expressed dissatisfaction concerning their own environmental measures and continued to develop and innovate the environmental management of the farm.

Size and landscape

In this category there were three small to medium sized farms, varying from 8–180 ha. They are, similar to the farms in the stewardship farming category, located in the mixed forest and mosaic landscapes. Two of the farms pointed out that they have specialised in using the 'marginal' land that is considered unusable by the larger scale land users (such as farms following a production vanguard logic). Such marginal land can be found outside the productive plain areas, the 'forest clays' as one respondent named it – scattered small fields with more meagre soils. One farmer (F18) grinned and said that he has more fields than hectares.

Environmental vanguards had diversified their production into niches of several crops, livestock, events, and off-farm jobs. All three also used an older and less expensive machine park, as they wanted the kind of machines that they can fix themselves and did not want to indebt themselves too much with new machines.

Land use strategies

The environmental vanguards farming logic farms adapt production to the different field conditions within the larger landscape in a similar way to the landscape stewards described above. The location of the farm and the fields, and how these could be limiting factors, were central in the conversations, expressed by one farmer like:

> This is that kind of farm; it lends itself to grazing and not so much to grain production. (F18)

All three farms within this category were organic producers and possessed livestock. A majority of their land was pasture, combined with areas of grain production. They described the cultivation of grass and its conversion into animal manure as the hub in the circulation of nutrients on the farm. They also designated ecological diversity as a positive farming objective and a precondition for farm production in general. In line with this, one of the main principles motivating farming strategy was to diversify their plant production whenever possible. For example one farmer cultivates ten to twelve grass species in their lay mixes, all environmental vanguards followed schemes for crop rotation for weed control purposes and managed the botanical values in natural pasture areas (by timing, grazing pressure, etc.).

Production and environmental goal conflicts

While discussing environmental/production goal conflicts with farmers in the environmental vanguard category, these farmers argued that environmental objectives are superior to the objective of maximising harvest levels and they describe their small to medium-sized production as more efficient than the large-sized grain production (a claim that was contested by the production vanguard group).

All three farmers in this category also described how they seek to promote biodiversity in the landscape as they see biodiversity as a fundamental feature of a functional farming system. Examples given of such actions were converting the vegetation of the field edges, putting abandoned pasture land back into production, and dividing larger fields into smaller, and the like. All measures requiring large amounts of labour.

They acknowledged that they at present don't produce large volumes of food but argued that their production system was effective in term of energy use while large-scale bulk production was an ineffective farming approach as it requires too much energy in relation to its output. They pointed out the need for systemic change of the farming systems and the farming sector in Sweden:

> It is not the volume that is our contribution, but to produce new more sustainable (farming) methods. (F17)

They argued that such methodological change is not supported by the farm sector, nor by academic institutions, and they therefore feel a responsibility (and curiosity) to actively contribute to the development of new small-scale production methods (F17; F5). They expressed how they wanted to develop an alternative to the cereal specialized farming (the production vanguard category), described by one farmer (F18) as a 'desert' (flat and sterile) landscape. They believed that the farm service industry (i.e., middlemen, extension service, trade organisations) tells the farmers what they want to hear, that is, to simply produce more and more while ignoring other more integrated landscape perspectives. This limits the possibilities for them to develop their businesses intellectually and they lack their own societal support structures. Two of them have joined a discussion group to discuss innovation on these kind of issues.

DISCUSSION

The main point we want to highlight is that farms that share some basic characteristics can display quite different farming logics. The empirical findings, for example, show how several 'notional family' farms (see Djurfeldt and Waldenström, 1999) work with different logics in their farming. The respondents F2, F13, F15, F17, F18; F21, F22 are all family farmers, but driven by either a landscape steward or environmental vanguard logic. Equally farms that at first glance can appear to be quite different – for example, conventional and organic farms – can follow a similar farming logic, for example respondent F8, a conventional production vanguard, and F11, an organic production vanguard. In terms of earlier Swedish typologies, F8 and F11 would both be big farms dependent on hired labor indicating in this case a closer affinity between this typological category and the production vanguard logic. These different logics exemplify van der Ploeg's arguments (2009: 138) that there are several ways to achieve a successful farm.

The logics that we demonstrate here relate to a variety of factors. First the logic is grounded in farmer identity, that is, how they would answer the question of what being a 'good farmer' means (Burton et al., 2008; Sutherland, 2013). We see this in the farmers quoted above who justify farm decisions with value laden statements framing decisions as proper, appropriate or the outcome as 'beautiful.' Logics also reflect the kinds of landscapes and agro-ecological conditions that the farms are situated in, as perceived by the farmers themselves (e.g., agricultural plains being suitable for grain farms or mosaic landscapes being just right for dairy production), at the same time that decisions that are informed by a particular farming logic affect the development of the landscape and production system. Finally farming logic also informs how farmers think about the production and environmental challenges of agriculture. We see this in particular in relation to how farmers relate to farm size increases and what their preferences are on protecting the landscape from negative environmental impacts. These are dicussed in more detail below.

Farming logic and increasing farm size

The production vanguard farms align with a longstanding dominant view of agricultural development. This logic is particularly voiced by large grain producers in the most productive areas (plains). Large-scale dairy, pork, and poultry farms could be based on this logic as well although such examples has not been present in our sample.

The continuous growth in size present production vanguard farmers with new problems, where logistical challenges, such as planning and moving machinery and labour to be in the right place at the right time over large areas. The centrality of logistics for large-scale farm operations was also mentioned in research on (Swedish owned) large-scale corporate farms in Eastern Europe (see in particular Kuns et al., 2016: 211), so in this regard the large-scale family farmers studied here are already expressing a similar logic to corporate farms. The question is if continuing development according to the production vanguard logic contains an innate tendency towards corporatisation, and if so what problems might this entail? In other words, would a growing family farm following a production vanguard logic transform into a farm corporation if the law were to change in Sweden? The Foundation, which is a kind of proto-landowning corporation pushes its tenants, as we described above, to increase in size and some farmers complain that the Foundation is already dominating the most productive land and the land market in the study area. The tentative answer is yes, but this needs to be studied more.

More generally, the ongoing rapid processes of structural rationalisation raises questions about *how* much bigger is better, or what size is best? When is the scale advantage outweighed by its environmental/'external' problems? The farmers in the landscape steward and environmental vanguards categories argued that the production vanguards have already crossed such a line, in particular pointing to the landscape changes due to the large-sized field units. On the other hand, the large size of production vanguard farms can also be viewed as an advantage for future land use systems. It generates large volumes of a necessary bulk production, and although no official data is available, we can assume it contributes the lion share of Swedish food production. Listening to the large-scale farmers' reasoning about the need to close the nutrient cycle by using sludge in agriculture, such large farms could be an interesting actor in pushing for an integration of the urban populations into nutrient cycling. The last decades have seen a debate in Sweden (e.g., Jordbruksverket, 2020) about spreading sludge on farmland and its related problems of heavy metals content and spread of contagion, versus possible techniques to extract phosphorus from the sludge. Independent of technical solutions, planning by large farms (and others as well) to connect their future farming to the urban city areas open up for new larger societal system perspectives of nutrient cycling in agriculture.

Farming landscapes and agroecology

The landscape sets the conditions for farming and connects closely to production orientation and intensity.

In line with Wästfelt and Eriksson (2017),[4] this study suggests contrasting agricultural landscapes with intensively managed agricultural plains and patches of less intensive production in mosaic and forest landscapes. This study also highlights the role of agriculture as an activity that both generates and harms ecosystem services crucial for the farm as well as the larger environment outside the farm, for example biodiversity.

What emerges clearly from the interviews is that the landscape stewards and environmental vanguards see themselves as managers of landscapes. These respondents described how they adapt the farming to the landscape at the same time as they co-create the landscape together with their livestock. Respondents also described how biological diversity was part of their farming logics as a key quality of their agroecological system. The mosaic, mixed and multifunctional landscapes with a long history of grazing in the study area are one of the most biodiverse landscapes that exist in Sweden (Olsson and Berg, 2008).

The trend today appears to be towards a continuous increase of farm scale and intensity, that is, more following the production vanguard logic, and the question is what does this mean for the agroecological integrity of the agricultural landscape? As mentioned above, there is a lot of evidence on how loss of biodiversity and other environmental problems are related to the homogenisation of farming landscapes (Benton, 2003; Belfrage, 2005; Tamburini et al., 2020). The continuously expanding size of the machinery stock also creates a situation where a growing share of farmland becomes 'marginal' land, because, as respondents said, the new machinery is simply too big for managing smaller, irregular fields or areas with narrow access. The result is such fields are taken out of production – a development that further re-enforces the already ongoing homogenization of agricultural landscapes.

At the same time, these intensely managed plains are some of the most productive soils in Sweden, that is, highly strategic areas for food production. The productive capacity of the plains is indeed an agroecological quality that needs to be taken into account, but as discussed above, we know that scale entails certain problems. The question is if there is a way to also promote diversity in farm production logics in the intensively managed plains? In terms of how policy might help intensive farm systems mitigate environmental impacts, the production vanguard farmers would like to see a shift from the current fragmented patchwork of generic environmental commitments (and payments) in the CAP system, to an environmental extension service developing farm specific environmental goals and actions connected to compensation. Some farmers in the plains are already testing farm specific measures of functional diversification of crops and plants in their land use systems, such as flower strips along field borders and in-between crops and/or integration of grass in the rotation schemes (c.f. Tamburini et al., 2020).

Does different farming logics complement each other rather than compete?

One vital aspect that runs through all interviews with the farmers in the three farming logic categories is a deep understanding of their land use as a *system* and the reasoning around soil fertility management, though the farmers with different farming logics then suggest diverse sets of actions for upholding what they consider a 'good' land use. But it shows how farming is not only about the immediate production; it is also about how to maintain or even increase the soil fertility as a key resource. Farmer's knowledge is key for the broader systemic approach needed for securing future agricultural production.

The farm with 100 ha sized fields, and the farm with more fields than hectares, work within distinct and completely different farming systems and farming logics. The large-sized production vanguards expressed a logic of 'rational and competitive' land as their main duty, whereas the environmental consequence of farming and heavy reliance on inputs in their land use system were downplayed. In contrast, the interviewed landscape stewards and environmental vanguards deemphasized the importance of production intensity, while other potential values of farming such as biodiversity and landscape beauty were given a high value.

Variation in farming logics here should not only be viewed as approaches that stand against each other as competing logics. Rather, these farming logic categories can, if they are not seen as linear and deterministic consequences of each other, be viewed as potentially complementary with mutally dependent roles in Sweden's overall food system. For example, on some of the farms that were a part of this study, organic and conventional approaches seem to be running in parallel rather than opposing each other. Also, farms with organic production are found within all three of the farming logics presented here. Some organic producers are as motivated to benefit from economies of scale and efficiency as conventional producers, while some conventional producers express curiosity about some organic farm practices. Our results here, thus, provide important context for understanding processes of the conventionalisation of organic production (Chongtham 2017; Darnhofer 2011), as well as the opposite tendency, the 'organification' of conventional production (Rosin and Campbell, 2009, cited in Sutherland, 2013: 430).

The dividing line in the debate among the interviewed farmers is however not between organic and conventional farming as such, but rather whether a lower intensity of production is seen as justified, and the high need for fossil fuel in the organic production versus the use of chemicals in conventional. Here we see our farming logic categories as tools to initate a meaningful discussion on production systems. In the future, land use systems will have to assimilate and combine multiple integrated practices to sustain robust food production landscapes. In this regard, the different farming logics can be seen as sources of possible production methods in a variety of conditions and contexts. There is already ongoing experimentation with such integrated production methods such as water harvesting techniques, multi-cropping methods, pioneering grazing regimes, and carbon sequestration measures in diverse sets of production by farmers.

CONCLUSION

We have shown how farmers have different farm development logics that are related to their visions, the production system and landscape, and broader political economic contextual factors. While farming systems with high levels of inputs have been the dominant approach for achieving continuously increasing production, there are today more and more questions about the ecological sustainability and resilience of such systems, not least in the face of a changing climate and the numerous uncertainties for farming that follow in its traces. Adding to uncertainty in food production is a worsening of the security environment in the Baltic Sea region, which has led to increased concern about the effect of trade disruptions on Swedish food security (Eriksson et al., 2020). Border closures due to Covid-19 have, moreover, reminded us about the fragility of international food supply chains (Clapp and Mosely, 2020).

Uncertainty in farming does not only mean that we lack knowledge of the probabilities of, for example, certain extreme weather events or their outcomes, but that we also lack knowledge in certain fields (i.e., integrated production). In the face of uncertainty, Scoones and Stirling (2020) propose an approach that emphasizes living with uncertainties as an inevitable aspect of society, rather than trying to reduce uncertainty to calculable risks. A consequence of such an acknowledgement is that we should accept diverse solutions, reflecting plural visions of progress and different scenarios with various outcomes. It is in this light that we want to engage in the debate about future food production in Sweden and future land uses.

Large-scale farming, with a logic of producing large amounts of food, are critical for future food supply. What is distinctive in the landscape steward and environmental vanguard logics is that the definition of the purpose and outcome of agricultural land does not focus only on production, but also includes the provision of ecosystem services such as biodiversity (Bommarco et al., 2018). In doing so, such farms fulfil an important societal function and are a strategic complement to the larger farms. However, if the expansion of production vanguard farms continues unabated it risks crowding out the landscape steward and environmental vanguard farms, which, given the simplication of landscapes that follow from the production vanguard logic, would ultimately compromise agricultural biodiversity. Such a development would also constrict variety in the farm sector, in a time when we need to keep more doors open.

None of the presented farming logics alone have the key to sustainable farming in Sweden. Rather, it is in the balancing of a combination of farms, with their diverse, associated farming logics and management practices, where a more sustainable agricultural production in the aggregate is to be found. For such a transition to take place, we need both to ask a range of useful questions about landscape, scale and production systems, and change the question from *what* is produced to *how* things are produced (Meyer von Bremen and Rundgren, 2020).

NOTES

1 In 2016, Sweden had 62,937 farms (Statistics Sweden 2020: 40).

2 As the case farms are primarily interesting as representatives of their different approaches to farming and land use logics, the data speaks to long term processes which are unlikely to have changed since the time of data collection.

3 Soil compaction damages is a significant problem in the study region due to its clay soils which are sensitive to compaction.

4 Wästfelt and Eriksson (2017) was in part based on the same empirical material.

ACKNOWLEDGEMENTS

We would like to thank all the farmers participating in the study for taking the time to talk with us. Kristina Marquardt's work has been funded by the Swedish University of Agricultural Sciences (SLU) project AgResources. Camilla Eriksson's data collection and initial analysis was funded by the SLU platform Future Agriculture. We would like to thank Karin Eksvärd and Mimmi Skarelius Lille who were part of the interviewing teams in those two studies. We received funding for merging the previous project results by the Future Food platform at SLU which has funded Kristina Marquardt's work with this paper. Camilla Eriksson's work has been supported by the Swedish Civil Contingencies Agency (Grant number 251-2014-1554) at her current affiliation at the Swedish Defence Research Agency. We express our appreciation to Adam Pain, Klara Fischer and Riccardo Bommarco for providing insightful comments on earlier drafts of this paper. Finally we wish to thank the editor and two anonymous peer reviewers for their constructive and helpful comments during the review process.

COMPETING INTERESTS

The authors have no competing interests to declare.

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TO CITE THIS ARTICLE:
Marquardt, K., Eriksson, C., & Kuns, B. (2022). Towards a Deeper Understanding of Agricultural Production Systems in Sweden – Linking Farmer's Logics with Environmental Consequences and the Landscape. *Rural Landscapes: Society, Environment, History*, 9(1): 1, 1–15. DOI: *https://doi.org/10.16993/rl.78*

Submitted: 15 January 2021 Accepted: 08 December 2021 Published: 19 January 2022

Rural Landscapes: Society, Environment, History is a peer-reviewed open access journal published by Stockholm University Press.