12 Realising Transformation in Response to Future Challenges

The Case of an Intensive Arable Farming System in the Veenkoloniën, the Netherlands

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12.1 Introduction

The Veenkoloniën (Figure 12.1) is located in two Northern provinces of the Netherlands – Drenthe and Groningen – and can literally be translated as peat (Dutch: *veen*) colonies (Dutch: *koloniën*). The prevalence of peat soils in the region has strongly affected its historical development. While small-scale peat extraction was common in the area in the Middle Ages, demand for peat exploded in the seventeenth century during the 'Dutch Golden Age' and expanded even further throughout the eighteenth and nineteenth centuries due to the development of the shipping sector that facilitated transport. Around the first half of the twentieth century, most peat was extracted in the region, resulting in sandy soils with relatively high organic matter content (Dutch: *dalgrond*) that characterise the region nowadays. Organic matter levels highly vary with a large share of inactive organic matter, which leads to low water-holding capacity, high vulnerability to wind erosion, and varying subsidence levels. The soil is unsuitable for cultivation of many crops and vegetables for two main reasons. Firstly, the relatively high organic matter content acts like a blanket, meaning that little energy can move from the soil to the air directly, making crops vulnerable to frost damage. Secondly, the potatoes and vegetables look dirty as a consequence of the brown peat-rich soil, which adheres to the products, making the product less aesthetically pleasing for consumers

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Figure 12.1 Typical landscape in the Veenkoloniën.
Photo by Yannick Buitenhuis.

(Smit and Jager 2018). Consequently, the region largely relies on starch potato production in a 1:2–1:3 rotation,[1] with starch potato being rotated every second or third year with mainly sugar beet and wheat. Although starch potato has been the most profitable crop in the region,[2] such a tight crop rotation increases the risk of plant parasitic nematodes. Yet, extending crop rotation to control for nematodes risk is challenging, as current price margins are already low. With an estimated net present value per hectare of arable land of 2,541 €/ha (Diogo et al. 2017), the region ranks amongst the least profitable in the Netherlands. Most farms are specialised either on arable crops or livestock; we focus on the former. There are a number of cooperatives operating in the region – Avebe (starch potato), Cosun Beet Company (sugar beet), Agrifirm (wheat processor and feed supplier) – yet we only consider Avebe as a part of the farming system, since Avebe depends on farmers in the Veenkoloniën for the supply of food

[1] The narrowest rotation is a four-year rotation of starch potato, sugar beet, starch potato, and wheat, resulting in a 1:2 rotation for starch potato, where the other crop is alternating every two years.

[2] At the farm level, most of the revenue comes indeed from starch potato production. On a hectare base, sugar beet is more profitable, but farmers are restricted to a 1:4 rotation of sugar beet and also due to the LLBs from the sugar industry. LLBs are 'Leden Leverings Bewijzen', which have replaced the sugar quota system in 2017. Sugar beet cooperative Cosun Beet Company has introduced the LLBs to be able to match demand and supply of sugar beets and decides each year on the amount of sugar beets that can be delivered by farmers to the Company. Besides, in the past the gross margin of sugar beet was higher than of starch potato, but since 2018 it is the other way around, due to decreasing sugar beet prices and increasing starch potato prices.

products much more than other cooperatives. The Annex 12.1 provides a graphical illustration of the farming system as considered in the analysis.

Until recently, the general expectation was that the arable farming system in the Veenkoloniën would eventually collapse due to two main challenges: a low level of agricultural diversification, and changes in the Common Agricultural Policy (CAP)'s financial support. Increased frequencies of extreme weather events, such as wind erosion, drought, extreme heat, or excess precipitation (Schaap et al. 2013), were expected to particularly affect starch potato production (Diogo et al. 2017), while soil limitations did not allow diversifying crop portfolios to reduce risk. Gradual abolishment of CAP coupled support for starch potato production in 2013 was estimated to result in an average decrease of direct payments from 450–750 €/ha (coupled) to eventually 350–400 €/ha (decoupled, incl. greening) by 2019, putting pressure on farm incomes (Immenga et al. 2012). A general response to all stresses and opportunities in Europe is enlargement of farms, also in the Veenkoloniën, as the number of farms has steadily declined by 39 per cent from 4,377 to 2,651 farms between 2000 and 2017 (CBS 2020). While this means that some farmers quitted, the region has shown remarkable resilience in the last two decades at the farming system level.

As for the future, the results of our farm survey in the region (see Chapter 1 for details) reveal that institutional challenges are still perceived as highly relevant in the next twenty years, but that farmers currently mainly worry about tightening the environmental policy requirements. At the same time, many arable farmers perceive environmental challenges, particularly nematodes and more frequent extreme weather events, as even greater long-term threats. Both institutional and environmental challenges are aggravated by low farm income, societal pressure to improve sustainability, and significant soil limitations.

Against this background, we first explore how actors in the farming system have dealt with its challenges in the past by identifying the farming system's sources of three resilience capacities – robustness, adaptability and transformability (Section 12.2). Next, we explain that resilience in the past is no guarantee for the future (Section 12.3) and present our vision on the resilience of the farming system in the future by reflecting on challenges and opportunities in the medium- to long-term (Section 12.4). Section 12.5 concludes the chapter. While this chapter mainly focuses on challenges, resilience capacities, and attributes, as well as future strategies to improve resilience, the Annex 12.1 provides a summary of the complete analysis of the farming system following the resilience framework (Chapter 1), i.e., also summarising the importance and performance of private and public goods provision, as well as the current state of adaptive cycles.

12.2 Sources of Resilience in the Past

According to CBS (2020), arable farming in the Veenkoloniën is characterised by its strong specialisation in cultivating starch potato, sugar beet, and wheat, mainly maintained through a strong collaborative network between farmers and other stakeholders in the farming system, such as the starch potato processing cooperative Avebe. The strong specialisation led to a farming system that performs very well regarding (food) production and could survive severe shocks in its current form (i.e., stay robust) or via adaptation, yet it limits the transformative capacity of the farming system (for details on the three resilience capacities see Chapter 1 and Meuwissen et al. 2019). Based on the farm survey, we found that the infrastructure for innovation and social self-organisation have mostly contributed to resilience in the past and helped the farming system dealing with these challenges, although during a participatory sustainability and resilience workshop stakeholders agreed that the levels of these resilience attributes can be improved (Paas et al. 2019).

Farming system actors, in particular Avebe, aimed to maintain starch potato production and responded to any challenge in the past with innovations, while also quickly involving other actors in the farming system in the innovation process. For instance, the abolishment of coupled support of the CAP for starch potato production in 2013 was overcome due to Avebe quickly adapting its business model and developing new products, including potato protein for human consumption, which led to higher prices for farmers. Similarly, Avebe has actively supported development of more productive cultivars with a higher starch content and higher resistance to nematodes. Other stakeholders have played an important role in facilitating innovation among farmers, including an agricultural innovation platform Innovatie Veenkoloniën that brings together key stakeholders in the farming system and facilitates knowledge exchange in the stakeholder network. Additionally, an experimental farm of Wageningen University & Research located in the region has spread examples of good practices. Indeed, many farmers in the region were found to be open to innovative starch potato varieties, green manures, and even new crops (e.g., onion), in order to extend crop rotation and reduce environmental risks. Another important stakeholder contributing to minimising the impact of extreme weather events and to improving soil quality is the local water board (Dutch: *Waterschap Hunze en Aa's*). The water board runs multiple projects aiming, among other things, to ensure enough water supply in case of drought and to increase resistance of farming to floods (Hunze en Aa's 2020). Innovations in the past allowed adaptation in response to challenges; they, however, never triggered a more radical transformation, e.g., away from specialisation in starch potato production. Innovations have always been introduced in time, often completely removing effects of a challenge, while at the same time pushing down incentives for transformation.

Collaboration between the farming system's stakeholders has contributed to resilience in the past even in the absence of innovation, e.g., in the case of financial support against extreme weather events. Since Avebe depends on starch production by its members (i.e., the farmers) and needs to ensure their profitability, they have paid a higher price to farmers to compensate for losses due to extreme weather events at a cost to Avebe's financial savings. In addition, farmers have increased financial savings in good years with high yields and prices that, for instance, helped to financially overcome the severe drought of 2018. Likewise, collaboration between arable and dairy farmers via exchanging their land allows extending crop rotations. The currently implemented two-year-rotation system allows devoting more land resources to starch potato but increases the risk of nematodes due to the intensive character of the production system. In order to extend crop rotation and reduce the risk of nematodes, arable farmers cooperate with livestock farmers by putting their land in one pool. In this larger pool of land, starch potatoes can be better rotated with arable and feed crops (Paas et al. 2020). By pooling land, arable farmers are able to devote half or more of their initial land resources to starch potato, while more easily controlling for the risk of nematodes. Livestock farmers also benefit from this system in terms of manure disposal, feed crops production, and grassland renewal, while Avebe also benefits from lower yield risks and an increased starch potato supply.

12.3 Resilience in the Past Is No Guarantee for the Future

Although the farming system managed to cope with several challenges in the past, there is no guarantee for survival in the future due to two main reasons: (i) the farming system is approaching its limits and (ii) current challenges may undermine resilience in the long run (Paas et al. 2020). Avebe requires enough starch potato supply to continue operation and hence aims to make the business viable for farmers by covering their costs (Meuwissen et al. 2020). By paying higher prices to farmers in bad years, the financial reserves of Avebe diminish, and hence there is a limit to the extent and duration of shocks that Avebe can cope with. The strategy is not sustainable in the long run, since in worse scenarios Avebe might not be able to pay farmers high-enough prices to remain viable, and farmers might abolish the cultivation of starch potatoes, leading to a drastic system decline, possibly leading to collapse. System dynamics modelling and participatory workshops confirmed that even marginal intensification of a challenge (e.g., decreasing yields due to nematode pressure and extreme weather events) can cause the farming system to collapse (Accatino et al. 2020; Paas et al. 2020; Schütz 2020). If droughts like those experienced in 2018, which decreased yields by 21 per cent, occur in two subsequent years, the system is expected to collapse in the long run if no additional strategies are implemented to cope with the challenges (Accatino et al. 2020; Paas et al. 2020; Schütz 2020). Also, cooperation between arable and livestock farmers to reduce nematode risk has always been uncertain due to the limited number of livestock farmers in the Veenkoloniën (Paas et al. 2020). Innovative starch potato varieties were recently found not to be resistant to new nematodes, and stakeholders are concerned that a 1:2 rotation may be impossible to maintain in the future (Paas et al. 2020). These evidences highlight the crucial importance of continuous innovation to remain within a safe operating space. Moreover, while strong specialisation on starch potatoes was beneficial for resilience in the past, it is perceived as rather constraining the transformative capacity in the future. For instance, demographic interviews and the risk management focus group revealed that there are concerns that prices for starch potatoes increased by Avebe did not encourage farmers to implement changes to their businesses; thus, enhancing the status quo within the farming systems. Although the status-quo is not necessarily disadvantageous, it is not seen as sustainable in the longer term for this particular farming system. The innovations implemented in the latest years, e.g., crop protection, soil quality improvement, and protective measures against wind erosion, are examples of adaptation, but no transformation, and lead to a more fundamental issue of lock-in, making it more and more difficult for all farming system stakeholders to deviate from the path (see Chapter 5 for further examples on lock-ins in other farming systems).

To this end, the farming system might approach critical thresholds soon if solutions based on current strategies are not realised in time (e.g., new cultivars, new crop protection products). This is aggravated by the fact that current agricultural practices are focused too much on production, while being partly decoupled from local and natural production capital. Based on system dynamics modelling for most of the envisioned future scenarios for European agriculture (Mitter et al. 2020), continuous investment solely aiming to maintain starch potato production is likely to limit radical transformation (Paas et al. 2019). Indeed, several future challenges, especially long-term stresses, require resilience capacities beyond robustness or even adaptability. For instance, maintaining and improving soil quality is undermined by current strong dependency on the intensification of arable farming and requires the farming system to introduce structural changes. Yet, some minimum level of robustness in the short term is essential for building up resources that allow adaptation or transformation in the long run. An additional challenge for the farming system in the Veenkoloniën is therefore to find a proper balance between the three resilience capacities in the future.

12.4 Opportunities and Strategies for a More Resilient System in the Future

12.4.1 Focus on Long-Term Challenges and Risk Management

As explained earlier, major challenges in the Veenkoloniën have shifted from operational and short-term shocks towards more structural stresses with long-term impacts on farms and farming systems, such as constantly changing environmental regulations and more frequent extreme weather events linked to climate change. In this regard, strategies and alternative systems also need to become long-term oriented, addressing multiple challenges and involving all the actors in the farming system. In particular, risk management should be understood in the broader context of resilience, compared to the traditional interpretation of risk management as targeting mainly economic functions (see also Chapter 2). We suggest defining risk management as the portfolio of instruments adopted by farmers in order to minimise the impact of challenges on the economic, environmental, and social functions (Slijper et al. 2020). Furthermore, risk management should not only ensure short-term robustness, but also enhance adaptive and transformative capacities in the long run (Spiegel et al. 2020). The diversity of strategies adopted in the risk management portfolio reflects a farmers' anticipation, coping, and response diversity to risk and uncertainty, preparing farmers for the unknown future. While current risk management portfolios in the Veenkoloniën are already fairly diverse, according to the farm survey, risk management instruments rather cope with short-term shocks and enhance robustness, for instance financial savings (currently implemented by ca. 57 per cent of surveyed farmers), agricultural insurance (40 per cent), and work harder in bad times (20 per cent). Instead, diversification in production and protecting the environment are examples of risk management instruments that target long-term stresses. Accordingly, all stakeholders involved in risk management in the farming system should reconsider their roles and perspectives in the future. For instance, financial institutions managing savings and providing insurance could focus more on financing innovations, in particular environment-friendly ones.

12.4.2 Exploit Existing Social Self-Organisation and Infrastructure for Innovation

As explained earlier, successful examples of resilience in the past can be linked to social self-organisation and infrastructure for innovation. We suggest capitalising on these existing resilience attributes in the future through interrelated strategies of cooperation and learning, not only among farmers and their cooperatives but also with banks and insurance agencies. This would maintain the current level of robustness, while stimulating adaptive and transformative capacity as well.

Cooperation might facilitate adoption of new technologies by sharing data and good experience among actors; examples here are

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precision agriculture and new methods of promoting soil life that in the future may enable targeting specific parasitic soil communities. Yet, more importantly, networks are essential for many strategies, such as a new type of water management, redesigning nature areas, and circular agriculture, that require tight collaboration of multiple actors (Paas et al. 2020). As explained earlier, extending crop rotation is currently done via cooperation between arable and livestock farmers. This cooperation does not rely on any formal regulations and hence requires very tight interactions and trust among farmers. In this regard, cooperation between actors might potentially enhance adaptability as it improves connectedness of the farming system via developing and tightening relationships (Cabell and Oelofse 2012).

Learning is one of the most popular risk management instruments in the Veenkoloniën (currently implemented by ca. 52 per cent of surveyed farmers) aiming to accumulate knowledge from past experiences, to experiment, and to anticipate changes (Darnhofer et al. 2010). Currently, several cooperatives in the Veenkoloniën (e.g., Avebe, Cosun, Agrifirm) organise local study events and clubs that have great potential to facilitate learning. However, these learning opportunities are often visited by the same farmers, as the results of risk management focus group and policy workshops suggest. Although there are different types of farmers also in terms of their willingness to learn, cooperatives are recommended to actively recruit new farmers and other farming system actors to the study clubs and facilitate discussion about both successful and unsuccessful practices. Also, learning can be beneficial for establishing and securing niche markets for newly introduced or rarely cultivated crops with cooperatives playing a key role. Recent examples showed that although some farmers adopted blueberry production, they were reluctant to share data with other farmers worrying that additional supply might ultimately lower market prices. Here, cooperatives might explore the demand and ensure that newly introduced crops can be successfully marketed.

12.4.3 Opt for Transformative Strategies, while Keeping Specialisation on Starch Potato

There are opportunities in the Veenkoloniën to employ the current level of adaptability in order to prepare for needed transformations without abandoning starch potato production in the region. One example is a more nature-inclusive production system that includes introduction, processing, and trading of new crops (onions, valerian, barley, blueberries), as well as sustainable soil management, maintaining and improving landscape, and innovative agricultural production techniques, such as precision agriculture. Transforming the system while keeping specialisation on starch potato production should aim to reduce production risks and shift the focus towards other functions, such as maintenance of natural resources and attractiveness of the rural area. Another promising option relates to strategies aiming to improve profitability in the farming system accompanied with adaptive strategies that release the pressure of starch potato production on the performance of the farming system (and vice versa). For instance, some arable farmers have already opted for innovative strategies that are not directly beneficial for the cooperatives, such as introduction of new crops. The aim of improving profitability is clearly visible in all proposed alternative systems where developing a good business model is identified as an important strategy.

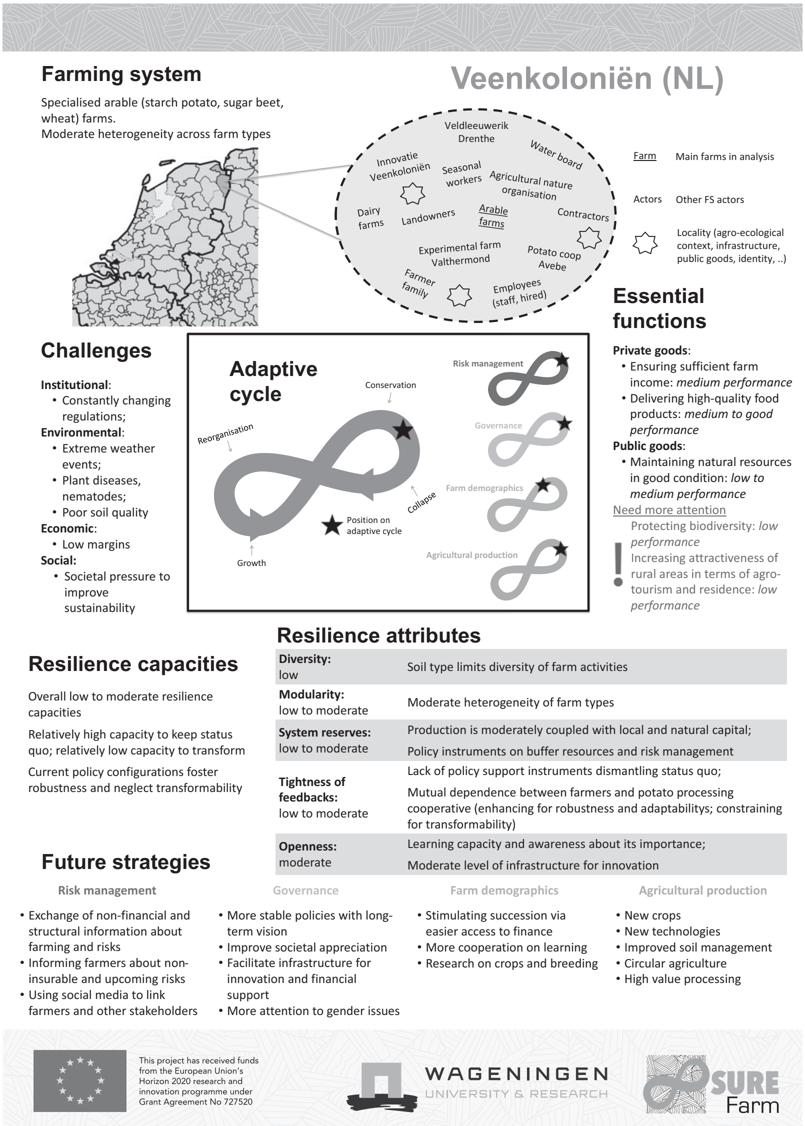
12.4.4 Exploit Opportunities of a More Radical Transformation beyond Starch Potato

Relaxing the already intensive crop rotation is another, probably more sustainable, option for the future. A 1:3 rotation would be more appropriate according to multiple experts within and outside the farming system (Paas et al. 2020). Yet, it would imply a substantial reduction of starch potato production and eventually reduces the strong specialisation on starch potato. Instead, farmers could gradually start introducing other protein-rich crops in their crop rotation, which is in line with the current political emphasis on a protein transition (Verstand et al. 2020). An alternative mentioned by Verstand et al. (2020) would be a transformation towards sustainable energy production by introducing solar panels. Non-farm activities, such as care farming and renewable energy production, could compensate for declines in farm income due to lower starch potato production. Any option, however, requires a certain level of support by stakeholders, whereas our stakeholder activities reveal their reluctance to move away from starch potato. In general, such a feeling of being stuck within a certain farming system is natural for every single stakeholder, especially when transformation would require joint actions of all stakeholders. In this case, a radical change is not likely to enter via the front door of joint vision and action, but rather via the back door of small-scale experimenting and learning between the farming system's actors and actors from other sectors, as well as citizens. Agricultural policy could support this process, by clarifying long-term regulatory boundaries, supporting innovation and providing compensation for the production of public goods (see, e.g., Buitenhuis et al. 2020; SURE-Farm 2020). This implies that agricultural policies should move away from generic measures that are in favour of the status quo within the Veenkoloniën, but instead offer tailored support for unconventional farming practices or alternative business models that help to reach desired outcomes.

12.5 Conclusion

The arable farming system in the Veenkoloniën showed that strategies successfully maintaining the status quo in the past are perceived by some actors as inefficient and even restrictive due to changes in the nature of major challenges and approaching critical thresholds, such that a transformation might be needed. The farming system needs to maintain robustness, while increasing adaptive and especially transformative capacities. Research on interdependencies between resilience capacities is extremely limited; literature suggesting specific strategies that maintain one resilience capacity, while improving the other two is lacking. Recommended future paths aiming to enhance resilience include an orientation towards long-term transformative strategies, as well as exploitation of existing strengths – enhancing social self-organisation, and fostering an infrastructure for innovation.

We have presented multiple strategies for a more resilient system without ranking them or highlighting any. It is important to note though that these strategies are not necessarily mutually exclusive. For instance, introducing precision agriculture might be an opportunity to develop an innovative and good business model. In fact, most of the alternatives rely on having a sustainable business model, tight collaboration between actors, active learning, and a developed infrastructure for innovation. These four elements might be addressed in different ways, depending on the specified pathways and goals that should be defined jointly by all actors. Furthermore, actors outside the farming system might contribute by bringing additional resources into the system and creating an enabling environment.



Annex 12.1 Factsheet synthesising resilience of the current farming system in the Veenkoloniën (the Netherlands).

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