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D6.2 Report on combinations of conditions for successful and unsuccessful fostering of resilience in agricultural sectors

Work Performed by P2 (KU Leuven) and P3 (ILVO) with case study partners

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1 ABSTRACT

Farming systems (FS) operate in biophysical, political, social, economic and cultural environments which are often far from stable. Frequently or unfavourably changing conditions can affect FS performance, i.e., the delivery of FS functions (such as food production or ecosystem services). The aim of task 6.1 is to identify principles for an enabling environment to foster (rather than hinder) resilient farming systems in Europe. Task 6.2 will translate these principles into roadmaps that will contain recommendations for both public and private actors and institutions in the enable environment on how to support farming system resilience. A farming system is a system hierarchy level above the farm at which properties emerge resulting from formal and informal interactions and interrelations among farms and non-farm actors to the extent that these mutually influence each other. The environment can then be defined as the context of a farming system on which farming system actors have no or little influence. Hence, actors belonging to the environment may be food processors, retailers, financial institutions, technology providers, consumers, policy makers, etc. Fostering FS resilience is done through (re)designing institutions and building and mobilising resources in order to enhance resilience enabling attributes of FS (and remove resilience constraining attributes). These institutions can be both part of the FS and part of an enabling environment, consisting of private actors (such as food processors, retailers, banks, etc.) and public actors (government agencies). Four archetypical patterns according to which challenges are insufficiently addressed to foster FS resilience have been identified. Six general principles underpinning patterns that enable FS resilience have been formulated. An important challenge is that FS and enabling environments should always find a good balance between addressing challenges in the short run and dealing with challenges in the long run.

2 INTRODUCTION

Farming systems (FS) operate in biophysical, political, social, economic and cultural environments which are often far from stable. Frequently or unfavourably changing conditions can affect FS performance, i.e., the delivery of FS functions (such as food production or ecosystem services). The dimension and direction of the changes of the environment are often uncertain and there are many unknown unknowns, i.e., events that cannot be imagined currently, let alone that their likelihood is known. Hence, safeguarding the functions of FS requires more than traditional risk management, which often assumes that the possible states of the future environment are known and that probabilities can be attached to each state, i.e., we know which shocks might occur and with which probability. This also means that it is not always clear how FS have to evolve to perform well in the future, since we do not know how that future will look like. Hence, the institutional and socio-economic environment in which FS are embedded should at the same time provide some direction to FS, but also help farmers keeping their options open and facilitate their flexible and smooth responses (Mathijs and Wauters, 2020). An important policy implication is that to make FS resilient, it is not enough to transfer a constant stream of transfer payments (direct income support—the approach to which most resources are devoted in the Common Agricultural Policy (CAP). Rather, policy but also private agri-food actors should assist FS actors to build resilience capacities beyond coping capacity (robustness) – which can amongst others be enhanced through a safety net but could be done through other approaches as well – but also responsive capacities (adaptability and transformability) through creating an enabling environment that supports adaptations and transformations (Buitenhuis et al. 2020).

The aim of task 6.1 is to identify principles for such an enabling environment to foster (rather than hinder) resilient farming systems in Europe. Task 6.2 will translate these principles into roadmaps that will contain recommendations for both public and private actors and institutions in the enable environment on how to support farming system resilience. A **farming system**, as defined in this project, is a system hierarchy level above the farm at which properties emerge resulting from formal and informal interactions and interrelations among farms and non-farm actors to the extent that these mutually influence each other (Meuwissen et al., 2019). The **environment** can then be defined as the context of a farming system on which farming system actors have no or little influence. Hence, actors belonging to the environment may be food processors, retailers, financial institutions, technology providers, consumers, policy makers, etc. The remainder of the deliverable is organised as follows. Section 2 discusses the analytical framework that is operationalised into a methodological approach in section 3. While case-study results are included in annex, section 4 provides a synthesis of results across case studies and ends with a set of guiding principles for a resilience-enhancing enabling environment.

3 ANALYTICAL FRAMEWORK¹

2.1 Defining resilience of farming systems

Figure 1 presents a dynamic, conceptual view on how resilience is built in FS in relation to its institutional and socio-economic environment. It builds on the original conceptual model that was developed by Meuwissen et al. (2019), enriching it with resilience concepts from the management literature (Duchek, 2020). Resilience capacities refer to the capacity of farms, farmers and farming systems to anticipate (future literacy), cope (robustness) and respond (adaptability and transformability) to shocks and stresses. Actors and institutions in the FS and in the environment allocate resources in order to produce and support the production of public and private goods (thus fulfilling system functions), but they can also divert resources to invest in resilience capacities. Improving resilience capacities means changing the resilience attributes, i.e., characteristics of the FS that determine its resilience. Examples of such attributes are sufficient levels of profitability, the level of modularity, the system's openness, the diversity and its flexibility (Meuwissen et al., 2019). Resources that are invested and mobilised can be of different forms. Financial resources may be invested in the farm business or set aside to form a buffer to deal with unexpected events. Farmers, FS and actors within the environment may also invest in cognitive resources, that is, knowledge and know-how, and network resources, that is, connections and social capital. Physical infrastructure may be built in order to better deal with changes within the environment, examples being storage and sensor technologies. Often, resources are not deliberately reserved for improving resilience attributes, especially those that support responsive capacities. There can be several reasons for that: farmers may lack resources because they cannot build up financial reserves or they have to use most resources for supporting current operational performance or there may be anti-push factors (e.g., attachment to or even vested interest in the status quo) and/or anti-pull factors (e.g., high risk aversion) at play.

¹ This section has been largely published as Mathijs and Wauters (2020)

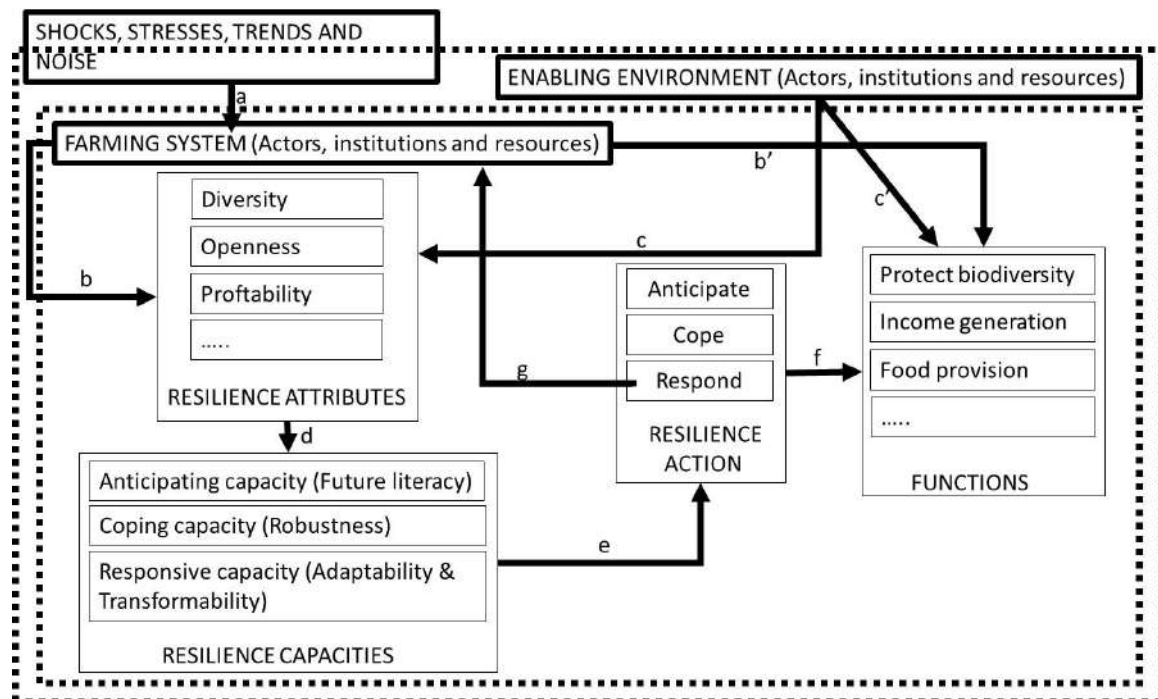


Figure 1: A conceptual view on building farming systems' resilience

a Challenges affect farming systems

b Farming systems actors may build and use institutions and invest resources strengthening resilience attributes

b' Farming system actors may invest resources into supporting current performance (functions)

c The enabling environment actors may build and use institutions and invest resources strengthening resilience attributes

c' The enabling environment actors may invest resources into supporting current performance (functions)

d Resilience attributes determine the level of the resilience capacities

e Resilience capacities determine how farming systems can deal with changes through resilience actions

f Resilience actions determine to what extent farming system continues to fulfil functions under the challenges

g Responses (adaptation and transformation) may lead to changes in the farming system, thereby affecting its resilience attributes and capacities.

Source: Mathijs and Wauters (2020)

Resilient FS are those where actors in the FS and/or in the environment have invested resources (in the broad sense, so including human and social capital) into supporting the resilience capacities in such a way that they are able to cope with challenges, i.e., they are robust against external pressure, in order to maintain fulfilling private and public FS functions. Robust FS are able to continue without having to constantly change, i.e., without having to constantly tap into their responsive capacities in order to trigger a response (adaptation or transformation). Nonetheless, besides coping capacities, responsive capacities have to be present. Indeed, at certain points in time, stresses build up, other types of challenges emerge and/or unanticipated shocks are so severe that farming systems are no longer robust, i.e., they are not able to continue to perform well enough in business-as-usual mode. At that moment, in order to continue to perform, farming

systems have to use their responsive capacities in order to respond². Such changes might be modest whereby the main characteristics of the farming system remain intact (adaptations) or they can be more radical changes to the farming system (transformations). The ease with which they can do this reflects their responsive capacities (adaptability and transformability). The goal is to become again robust within the new environment so that they are again able to perform well within the changed environment, without having to constantly make bigger changes beyond minor changes that are part of operational management. Further, these responses can also change the characteristics of the farming system in such a way that the resilience attributes and hence the resilience capacities themselves are affected. Anticipating capacities – referring to the capacity to detect trends that could lead to critical changes to the farming system and its environment and to be proactive – influence both the coping capacities and the responsive capacities on the one hand, and the need to use them on the other. As such, farming systems with high anticipating capacities are more resilient. Together, anticipation capacities, coping capacities (robustness) and responsive capacities (adaptability and transformability) determine a farming system's resilience (Meuwissen et al., 2019; Duchek, 2020).

2.2 Fostering farming system resilience

Fostering FS resilience means building, mobilising different types of resources (in the broad sense, so including human and social capital). These resources are partly located both inside the FS (e.g., farmer savings) and in the enabling environment (e.g., government budget, food processor investments). In addition, within the FS resources are not evenly distributed and access to resources is also not evenly distributed between FS actors. The same holds for resources invested by the enabling environment. An important question is about the right balance of resources held or invested by the farming system and the enabling environment.

For instance, resources can be built and mobilised by the government. Agricultural research, especially in areas less attractive to private investors, is often funded by governments as individual farms are too small to set aside meaningful resources for research. Disaster funds are another example. On the other hand, resources can be invested—and capacities built up—by individual farmers, provided they make a profit. Hybrid models exist in which groups of individuals pool resources that may be matched by government funds, as for instance in the case of government-subsidised crop insurance. The question remains then how individuals and groups may have access to capacities and resources. It seems logical that a minimum amount of capacities and resources is needed at the individual level in order to get access to and absorb knowledge

² It can be argued that farming systems do not need to adapt at discrete moments in time, but that they need to continuously adapt to address challenges and opportunities.

developed at the collective level. Whether capacities are built up by mobilising resources in a collective or rather individual way and by public actors, private actors or rather through hybrid ways depends on the type of challenges (e.g., the distinction between normal risk and catastrophic risk), but also on political mechanisms and priorities (e.g., whether society considers it a social or rather individual responsibility to support farmers to manage income volatility), and on historical path dependencies or institutional arrangements across the value chain (e.g., vertically integrated value chains versus spot markets) (Mathijs and Wauters, 2020).

How resources and knowledge are distributed and accessed among farming system actors depends on prevailing institutions both inside the FS and in the enabling environment. Information and power asymmetries lead to inequalities in terms of access to resources and capacities. Policies such as the CAP determine whether and how capacities and resources can be accessed and activated by those who need it. This also includes gaining insights in institutions (formal and informal rules) that govern behaviour of the actors and influence the interactions and relationships among actors. Institutions are “enduring regularities of human action in situations structured by rules, norms, and shared strategies, as well as by the physical world. The rules, norms, and shared strategies are constituted and reconstituted by human interaction in frequently occurring or repetitive situations” (Crawford and Ostrom, 1995: 582). Formal and informal institutions influence how resources (knowledge, money, power) are allocated to activities that help farmers and FS to anticipate, cope with and respond to adverse events. For instance, national knowledge and innovation systems may be focused on a limited set of farming system models, paying insufficient attention—and thus resources—to the broader diversity of farm models. Private standards that include provisions on the homogeneity of products could be a barrier for system diversity. The CAP may play a huge role here, as it determines who gets subsidies (direct income support, coupled payments, investment support, etc.) and who not, and also how market management measures may be used.

4 METHODOLOGY

Investigating how the environment influences (enables or hinders) FS resilience was done by analysing how resources and institutions were mobilised in both the FS and environment and how they affected resilience capacities in the past, that is, following a set of challenges and adverse events in the past 10 years. For this, a five-step methodology was followed. The analysis was performed for 11 case studies: large-scale arable farming in Northeast Bulgaria, intensive arable farming in Veenkoloniën, the Netherlands, arable farming in the East of England, large-scale corporate arable farming with additional livestock activities in the Altmark in East Germany, small-scale mixed farming in Northeast Romania, intensive dairy farming in Flanders, extensive beef cattle systems in the Massif Central, extensive beef and sheep farming in central and Northeast Spain, high-value egg and broiler systems in Southern Sweden, small-scale hazelnut production in Lazio, central Italy, and fruit and vegetable farming in the Mazovian region, Poland.

Step 1: Identification of farming system and enabling environment actors and institutions

Even though the theoretical border between the farming system and the enabling environment is clear, empirically, this distinction remains fluid and FS (and thus environments) have been defined differently in the different case studies, all actors and institutions in the combined FS + enabling environment are considered. In addition, identifying all actors and institutions ensures that no relevant actors and institutions are forgotten in the analysis. Formal, informal, hard and soft institutions were all considered. Formal are those that are really regulations (e.g., fiscal policy, private standards, CAP, nitrate directive, ...); informal are institutions that equally guide actors' practices and interactions between them but are unwritten and not formally institutionalized in regulation (e.g., local customs with regards to cooperation, level of representation in policy design, common visions on the ideal farm, ...). Both public (including all government levels and domains) and private (including business actors such as processors, retail, farmers, ...) institutions in both the FS and the enabling environment were considered.

Step 2: Identify challenges and adverse events in the last 10 years

Between 5 and 10 challenges/adverse events the FS faced in the last decade have been described in each case study. Also the type of each challenge was identified (based on Maxwell, 1986):

- **A shock:** sudden changes that are usually difficult to predict, such as the COVID-19 crisis or the Russian embargo.
- **A trend (or stress):** gradual changes that are usually more easy to predict than shocks but not less important. Examples are increasing societal pressure to produce more

sustainably, declining real farm gate prices, and increasing pressure on land from non-agricultural stakeholders.

- **Noise (normal variation):** the kind of variation that occurs regularly, that is usually not such a surprise as shocks, and usually less challenging than stress (trends). Examples are weather variability, moderate price volatility, rainfall variability. Of course, within this normal variation, sudden shocks might appear which are more severe (e.g., price drops to levels outside normal variation) and they can become stress (e.g., rainfall variability which become gradually more variable)
- **Cycles.** This is a type of change which does not often occur (anymore) in socio-ecological systems such as farming systems, but some challenges could be in this category. Commodity price cycles are an example, but even those seem to be more a phenomenon of the past. Hence, this category is mentioned here for the sake of completeness.

The type of challenge may matter as the dynamics of reactions in the farming systems + enabling environment may be different for different types of challenges.

Step 3: Analysis of reactions

For all or a sub-set of identified challenges, a number of analytical steps were taken, guided by the analytical framework (figure 1). The following questions were used for orientation:

- what was the (possible) impact of challenges on the delivery of FS functions and did this threat materialise, i.e., what has been the actual impact;
- were and if so, how were challenges anticipated by actors in the FS and in the enabling environment;
- how did the FS cope with challenges (referring to robustness); here, for the ease of analysis and interpretation the FS is narrowly defined by the set of farmers in the farming system. A further question was what role the enabling environment played in these coping reactions;
- how did the FS (so mainly the farmers) respond (referring to adaptation and/or transformation) to the challenges, and again were they assisted (or hindered) by the enabling environment.

Step 4: Pattern analysis

In order to explore the functioning of the enabling environment (and more specifically its impact on resilience capacities), actions identified were classified according to **systems archetypes**. In other words, a **diagnosis of the enabling environment** was carried out using the lens of systems archetypes. Kim (2000: 2) defines systems archetypes as a “class of tools that captures the ‘common stories’ in systems thinking—dynamic phenomena that occur repeatedly in diverse

settings. They are powerful tools for diagnosing problems and identifying high-leverage interventions that will create fundamental change”. They are usually depicted as causal loop diagrammes. For instance, Brzezina et al. (2017) have used systems archetypes to analyse the development of organic farming in Europe. Oberlack et al. (2019) carried out a systematic review of archetype analysis in sustainability research, including the main motivations for and limitations to carrying out this type of analysis. Refer to Kim (2000) for an overview of systems archetypes used in this analysis.

Step 5: Cross-case analysis

Cross-case analysis was carried out using all 11 cases to investigate whether the same systems archetypes were found, but also to match archetypes to the type of challenge. This allowed us to identify leverage points or **principles** for the enabling environment to change from hindering to fostering farming system resilience, for each archetypal problem has a set of archetypal solutions. These principles were illustrated by examples of a fostering enabling environment identified in the various case studies.

The results of the first four steps can be found in annex for each case study. In what follows, only results of the fifth step are discussed, but examples of all case studies are used to illustrate the archetypes identified.

5 RESULTS

5.1 Actors and institutions in FS and their environments

All case studies pointed to the importance of both public and private actors, and also mentioned both positive and negative actions taken by these actors. We refer to the individual case study reports in annex for a detailed overview of actors in each case study.

5.2 Challenges and adverse events

Table 1 lists the most important challenges mentioned by the various case studies, ordered in frequency of appearance. The occurrence of extreme weather events and the low attractiveness of agriculture for farmers resulting in lack of generational renewal have been mentioned by almost all cases. Challenges mentioned by half the cases include regulatory changes, increasing societal expectations (mostly in terms of environment), price volatility and the lack of skilled workers. While these challenges apply to many FS contexts, other challenges are more context specific, that is, relate to the nature of the FS itself and its enabling environment. Examples include land ownership in Northeast Bulgaria or lack of regional infrastructure in the Altmark.

An important observation is that most challenges appear as **trends**, such as low attractiveness of agriculture, societal expectations and lack of skilled workers. Challenges such as extreme weather events and price volatility tend to be experienced first as shocks but then as these shocks reappeared, these challenges also became trends.

Table 1: Frequency of challenges mentioned in 11 case studies

	BE	BG	DE	FR	IT	NL	PL	RO	ES	SE	UK
Extreme weather events	X	X	X	X	X	X	X	X	X		X
Low attractiveness of agriculture		X	X	X	X	X	X	X	X	X	X
Regulatory changes		X				X		X	X	X	X
Increasing societal expectations	X	X	X	X	X					X	
Price volatility	X	X	X				X				X
Lack of skilled workers		X					X	X	X		X
Zoonoses, pathogens and other hazards					X	X			X		
Bureaucracy			X				X				
Industry concentration				X	X						
Lack of regional infrastructure			X						X		
Soil fertility		X				X					
Land ownership		X									
Russian embargo							X				

BG = large-scale arable farming in Northeast Bulgaria, NL = intensive arable farming in Veenkoloniën, the Netherlands, UK = arable farming in the East of England, DE = large-scale corporate arable farming with additional livestock activities in the Altmark in East Germany, RO = small-scale mixed farming in Northeast Romania, BE = intensive dairy farming in Flanders, FR = extensive beef cattle systems in the Massif Central, ES = extensive beef and sheep farming in central and Northeast Spain, SE = high-value egg and broiler systems in Southern Sweden, IT = small-scale hazelnut production in Lazio, central Italy, PL = fruit and vegetable farming in the Mazovian region, Poland.

5.3 Reactions

Anticipation

An important observation is the general lack of anticipatory capacity and thus proactiveness in the farming system but also in the enabling environment. Whereas shocks are often difficult to anticipate, the lack of anticipatory capacity is also observed when it comes to trend-like challenges, which are often ignored or downplayed and are not sufficiently triggering actions to exploit or improve the resilience capacity of the farming system. This seems to be the strongest in the Spanish lamb FS, where the reduction of lamb meat consumption, lack of access to land and other challenges have for long received insufficient attention, leading to a situation that can no longer be solved. The enabling environment itself can also lack a proactive attitude. For instance, in the UK, the arable case study suffered from a lack of preparation and planning related to the challenges introduced by government itself (Brexit and neonics ban). Another example relates to the increased occurrence of adverse weather events (e.g. droughts), for which anticipatory capacities only improve after repeated incidences of such events.

The lack of anticipatory capacity can be described by not being able to imagine certain different futures, even while the changes are – slowly – taking place. A recent example for a challenge that could become relevant in the near future is the replacement of cows' milk by lab-made milk and dairy products. Whereas investments are being made, promotion campaigns are being set-up and companies lobby for regulatory reform to remove any barriers to lab-based dairy, very few actors in the farming system nor the enabling environment anticipate this possible threat.

Anticipation may, however, improve, when certain challenges reoccur. For instance, the reoccurring milk price drops in the Belgian dairy FS have increased anticipation somewhat, although the conflation with other unpredictable factors (e.g., Russian embargo) makes more precise anticipation often difficult. In other cases, anticipatory capacities are higher when shocks are announced beforehand, such as subsidy changes or the milk quota abandonment.

Coping

A strong coping reaction can be observed across all case studies, in the first place by FS actors themselves tapping into their buffer capacity. In almost all cases, additional actions from the enabling environment (particularly public actors) were necessary to prevent too high income losses. Examples are additional income support from the government, earlier distribution of CAP-payments, government intervention in markets through buffer stocks, negotiated price premiums paid by retailers or the recognition of adverse weather events as “disaster” which triggers the use of public disaster insurance pay-outs. In addition, most actions from the enabling environment seem to enhance robustness as demonstrated in most cases, as very often the possible impact did not fully materialise and actual impact was smaller. This on its own in many cases reduced or delayed the perceived need for using responsive capacities in order to adapt or transform, as will be explained further below. A notable exception is the Swedish poultry case, in which the enabling environment (both public and private actors) accelerated the adaptation towards more animal- and environment-friendly production systems.

Response

Response in the form of system adaptation or even transformation has been observed mostly at individual farm level (e.g., Belgian dairy FS) with the extreme case being increased farm exit (all case studies). As indicated earlier, adaptation at FS level has been observed only in the Swedish poultry FS and the Spanish FS. This suggests adaptation requires time, particularly when an entire FS is adapting. Adaptation did occur at individual farm level, for instance when certain challenges reappeared (e.g., price drops in the Belgian dairy FS) resulting in increased adaptive response, for instance by converting to organic agriculture or adaptations/transformations towards diversified business models including, e.g., short supply chain marketing. However, it is difficult to attribute

system adaptation or transformation to a single challenge, as challenges usually interact with other (see French beef FS).

5.4 Patterns

In this section, we discuss the archetypes that occurred most often in the various case studies. Our analysis resulted in four archetypes: (1) a pattern in which mitigating symptoms prevail over finding structural solutions (fixes that fail/shifting the burden), (2) a pattern in which actions are taken to downplay the challenge itself (eroding goals), (3) a pattern in which the enabling environment inhibits FS action (limits to growth) and (4) a pattern in which too much attention is given to particular solutions (success to the successful).

We illustrate each of these patterns with examples from the various FS case studies (without being comprehensive). We refer to the annex for a more detailed analysis of these examples, more examples of these patterns and examples of other patterns that may have been observed.

Archetype 1: Fixes that fail / Shifting the burden

A challenge triggers a coping reaction in which the enabling environment provides external interventions to mitigate the symptoms generated by the challenge rather than providing a structural solution to the challenge (fixes that fail). Moreover, such interventions may produce a side-effect that undermines the structural solution in the long run (shifting the burden).

This pattern occurs when the following conditions prevail:

- The challenge cannot be sufficiently absorbed by the farming system or economic actors in the enabling environment without substantial loss of income (insufficient coping capacity), triggering a request to the enabling environment to mobilise resources or change rules
- The financial losses are large enough and interests of those hurt are represented well enough to trigger action by government (form of connectedness)
- Responsive capacity is insufficient, which can have several reasons: solutions are not known, adjustment costs are too high, vested interests in the status quo, etc.

Actions are primarily taken by government, based on the financial reserves they can mobilise or the amount of leeway that exists to temporarily change certain regulations. This may be enough when the challenge is temporary and/or the impact is relatively small, but when the challenge persists or reappears, the problem also reappears (e.g., extreme weather events, price drops, lack of labour). But also actions by some private actors may result in a status quo due to the vested interests they have in maintaining production at current levels.

Moreover, mobilising resources or changing rules to cope with the challenge actually undermines the implementation of structural solutions. Strictly speaking this is always the case, as resources mobilised for developing symptomatic solutions cannot be devoted for developing structural solutions. However, we could argue that as long as effects are not irreversible, such resource allocation only results in a delay, not in the impossibility of the structural solution. Hence, an important condition for a shifting-the-burden pattern to occur is that the coping strategy involves actions with relatively irreversible implications (for instance, the destruction of certain resources or the creation of technical, economic or institutional lock-ins that are difficult to break). This pattern has been observed in all case studies, following different types of challenges, both as a reaction to shocks and to trends.

First, reactions to shocks such as extreme weather events fit this pattern well. The enabling environment—primarily government—frees up reserves to pay out farmers for income losses. When government keeps doing this unconditionally, farmers have no incentive to invest in solutions in which they adapt towards a system that is less exposed to these events (see figure 2). This was mentioned in the UK, Polish, French, Dutch and Belgian FS. For instance, in the French beef FS, droughts induce farmers to change land use and cropping for feed, that is, they react to the decreased grassland productivity following droughts by reducing permanent grassland while increasing cereal production and temporary grassland. In addition, farmers increase feed purchase from providers external to the FS. Structural solutions would imply adapting the system to more drought tolerance through improved practices and technologies and even different cattle breeds.

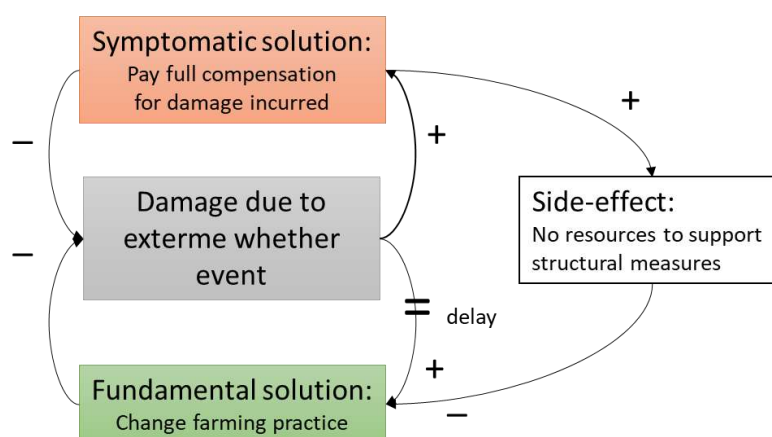


Figure 2: Causal loop diagramme of the shifting the burden archetype

In the Dutch starch potato FS, the processing cooperative has increased prices paid to farmers following a decrease in EU subsidies, such that farmers did not need to adapt their production plan. However, this reduced the incentive to reduce farmers' specialization in starch potatoes. A similar pattern can be observed in reaction to nematode pressure: rather than increasing crop rotation, farmers have been intensifying potato production using external inputs.

The pattern has also been observed in the Spanish lamb FS, where income support was mentioned as a fix that fails. The FS has been under economic pressure due to decreasing national lamb consumption, but this trend has not been picked up by the FS and its enabling environment. One reason is that FS actors are taken too much by short-term challenges in order to be able to notice possible future trends (low anticipatory capacity). At the same time, the enabling environment has fostered primarily solutions aimed at increasing robustness, such as marketing campaigns to promote lamb consumption.

Reactions to price volatility also seem to fit this pattern well. For instance, the 2009 milk price drop was by most in the Belgian dairy FS regarded as a shock, even though it was part of a trend where dairy farmers in most of the EU became more exposed to price volatility than before, because of larger participation in the world market against which they were less protected after the CAP reform. Farmers exhibited some coping capacity by using buffer capacity (financial reserves, off-farm income), networks and relationships (negotiating solutions with suppliers and banks, possibly including transfer of property), savings on costs, early culling, and delayed investments. The enabling environment acted swiftly to increase current coping capacity, mainly through mobilizing public resources, that is, market measures and income support measures (EU), bridging loans (Flanders) and a temporary bonus on milk price paid to farmer (paid by consumer via retail). At the same time, limited signs of responsive capacity were observed: the farming system did not really adapt or transform.

Another observed example of the fixes that fail archetype is when farming systems insufficiently deliver public functions such as keeping natural resources in good conditions, e.g. through too much harmful emissions. A – relatively quick and easy – fix is to implement technical solutions – technical fixes – that improve the eco-efficiency, i.e., reduce the amount of emissions per unit of production. However, over time this fix seems to fail, and the challenge remains, or is even more severe. The root cause may be the amount of farming, e.g., livestock concentration, in a certain area, which requires more fundamental solutions than reducing emissions per animal.

A final example relates to the problems related to land ownership in North-East Bulgaria. During the last three decades many solutions have been searched for but the radical changes which are needed to force landowners to be interested in long-term decisions are still only discussed, e.g.

property taxes, to take responsibility in land management and to be accounted for damaging soil quality.

All these examples involve actions by the FS supported by the enabling environment that strengthens robustness and coping capacity in the short run, but that do not address the challenge itself or adapts the FS in order to reduce exposure to the challenge. As a result, FS actors may become 'addicted' to the external intervention that mitigates the symptoms.

Archetype 2: Eroding goals

A challenge creates a gap between a goal and the actual condition. Rather than taking actions to improve conditions, actors adjust the goal (e.g., downplaying the challenge, redefining or reinterpreting the problem differently) in order to justify lack of action.

This pattern occurs when the following conditions prevail:

- The challenge is a trend, the impact of which has not materialised yet into income loss, because the impact is absorbed by the FS
- Why the impact is perceived as small can have several reasons: the cause-effect relationship between trend and income loss is ambiguous because of other conflating factors, the trend itself is being underestimated, resources are invested in shielding the FS from the challenge

The pattern not only involves a lack of anticipatory capacity (by not adequately picking up a challenge), but also the deliberate actions to try to remove or mitigate the challenge itself. A typical result is shifting the deadline of reaching a goal to delay action or in the hope that the problem will "go away". The danger is that this pattern results in a situation that ultimately cannot be solved anymore (which is why it is often referred to as the boiling frog archetype). The pattern has been observed in a more limited set of case studies.

This pattern can often be observed as a reaction to societal concerns. For instance, the Belgian dairy FS is exposed to growing civil society opposition against intensive livestock farming, based on environmental, animal welfare, and health reasons. This trend is present for quite long, whereas initially meat was more targeted, recent years have seen a large increase in opposition and now also milk has become a target. Efforts of the FS and enabling environment mainly focused on removing or slowing down the trend. Examples include positive image building campaigns to off-set negative images, in sound ways (communicating about progress being made) and less sound ways (discrediting civil society organisations and individuals) and lobbying to delay new environmental or animal welfare regulation, or to lower proposed standards (figure 3).

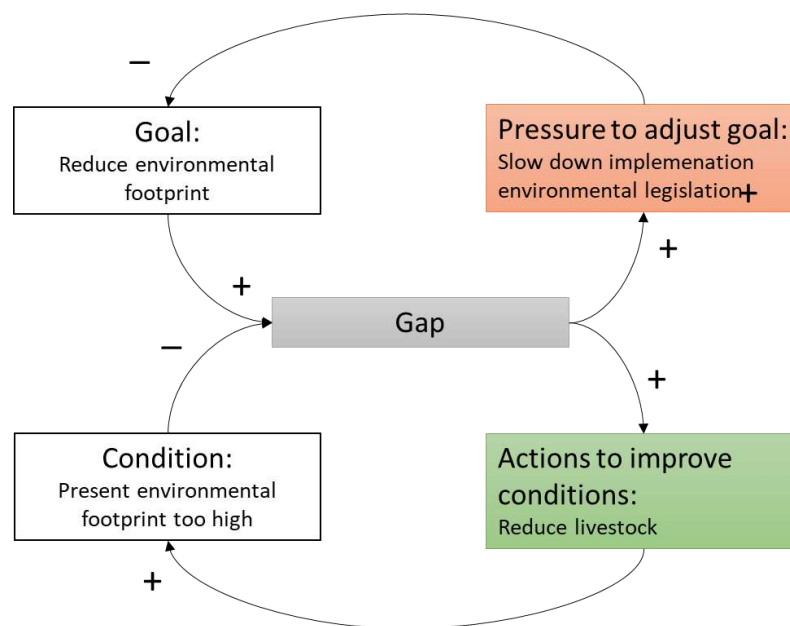


Figure 3: Causal loop diagramme of the eroding goals archetype

A similar pattern can be observed in the Spanish lamb FS where lack of awareness of the seriousness of several challenges occurring at the same time (decreasing consumption, access to land, etc.) led to insufficient response by both FS and enabling environment. One observed reaction – marketing campaigns to increase consumer demand – has the intention to slow down or even reverse the trend.

Archetype 3: Limits to growth

Actions taken by the FS, for instance to address challenges, are inhibited or slowed down by actions in the enabling environment.

In this pattern, FS actors are willing to take coping or responsive actions, but they are inhibited by actions taken by the enabling environment, for instance because of too much red tape, insufficient resources invested in the proposed solutions, etc.

An example of this pattern was found in the Polish horticulture case. High levels of bureaucracy following the request for more precise data, monitoring and controlling procedures, and variability of regulations have provided an important impediment on developing solutions. The

lack of attractiveness of the agricultural sector, leading to lack of successions, can also be explained with the limits to growth archetype, in cases where the enabling environment has a negative impact on the attractiveness of the sector. Several cases mentioned the bad bargaining power position of farmers in the value chain as such a hampering factor (figure 4).

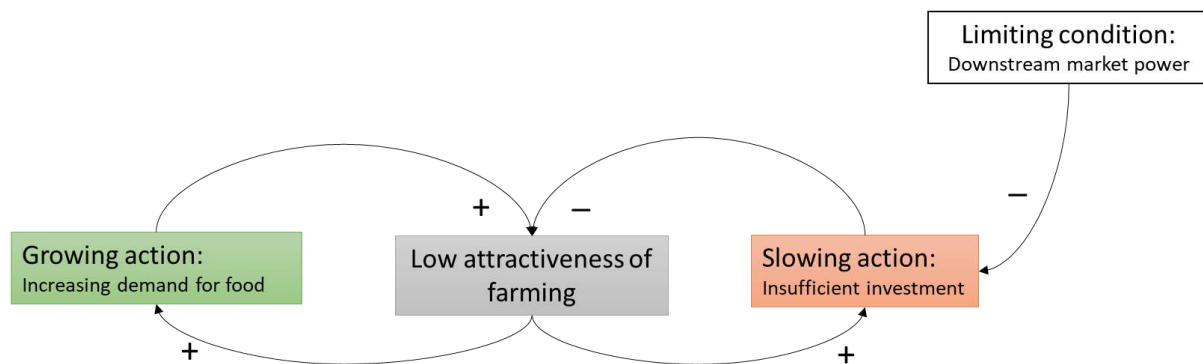


Figure 4: Causal loop diagramme of the limits to growth archetype

Archetype 4: Success to the successful

Resources are allocated to a limited number of apparently successful actions—and thus not in other actions. A side-effect may be that investing too much into one solution may backfire into a fix that fails.

Here, the enabling environment allocates resources unequally to different solutions or actors. For instance, allocation of resources may depend on being able to demonstrate earlier success. As a result, there will be underinvestment in other solutions and actors, which may backfire if the supported solution turns out to be insufficient or even detrimental. This archetype can also create path dependencies where it becomes difficult to change the course of action (figure 5).

An extreme example of this pattern can be observed in the German case. The Altmark region has been allocated relatively less resources by the enabling environment due to its spatial remoteness and low population density, which results in continuous marginalisation of those already marginalised. Lack of infrastructure, such as the internet, decreases the ability to take opportunities (e.g., internet based sales, precision farming). A more specific example of this pattern was observed in the same case study where government subsidised biogas installation as a way to diversify incomes. However, in some cases the farm financial situation worsened due to high costs.

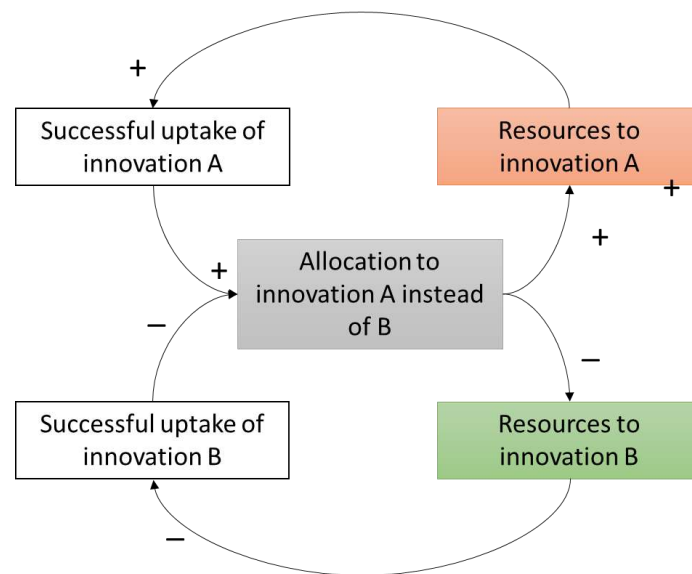


Figure 6: Causal loop diagramme of the success to the successful archetype

5.5 Principles

To derive guiding principles underpinning an enabling environment that fosters (rather than hinders) FS resilience, we identified interventions in the four archetypes that lead to more desirable outcomes, that is, FS resilience in the broad sense (addressing robustness, adaptability and transformability). We thus derived six principles for a resilience-fostering enabling environment.

Principle 1: *When a FS cannot cope with a challenge to avoid severe income losses, the enabling environment—and particularly government—should provide temporary resources to cope with the adverse consequences of the shock, but only to buy time while working on the real remedy.*

Before a system can adapt or transform, it first needs to cope with the challenges at hand to survive. When a system cannot cope with challenges in the short run, it can also not adapt in the long run, as adaptation requires sufficient resources (of all types, financial, legal, human, social). This principle is already very much being applied in most farming systems, often to that extent, however, that it gives rise to the ‘Shifting the burden’ archetype, whereby all resources are allocated to solving the symptoms, which reduces the pressure to implement more structural solutions. Hence, important to note is that resources from the enabling environment should only be mobilised when FS cannot cope themselves, for instance, because the challenge is too systemic and has too large impacts. Ideally, an a priori rule should be determined to decide when and when not to intervene. Further, the temporary nature of the compensation is crucial. If the

compensation pervades, the incentive to adapt decreases (addiction phenomenon). Hence, these temporary resources should only be used to buy time while working on real solutions. An example is an extreme weather event, such as drought. When the drought hits, only coping is possible, and when the drought is severe resource mobilisation is appropriate. However, resources should also be invested into structural solutions able to deal with droughts, such as the development of drought-tolerant varieties.

Principle 2: *When shocks occur, resources should be shifted towards building anticipatory capacity as well as responsive capacity, to prevent addiction to external solutions and to increase future coping capacity of the FS. This should be done jointly by all types of actors in the FS and the enabling environment.*

Often, a one-time shock is regarded as a very exceptional event, which makes it logical not to adapt. However, when a shock occurs, simultaneously with alleviating the immediate consequences – if they are too severe to be coped with by the FS (Principle 1) – anticipatory capacity should be built in order to anticipate whether reoccurrence of such shocks is likely. Today, actors in both the FS and the enabling environment often fail to do so, and the likelihood of reoccurrence is being underestimated, or priority is given to actions to reduce the probability of a next shock, rather than to actions that increase resilience to the next shock, such as adaptations or transformations. Besides anticipatory capacities, responsive capacities should be built. Examples include extreme weather events and price drops. Experiences from previous shocks can then be used to better cope with the challenge next time around (also by better anticipating the challenge) and to prepare adaptation strategies. Such a pattern can be observed in the EU dairy sector: the first price drop was largely unexpected, but the next price drops were better anticipated and more coping strategies (e.g., futures-like instruments) and adaptation strategies (e.g., shift to organic) were applied. However, this only occurred after the third price drop, and in between, time and both private and public resources were lost, and many individual otherwise healthy farms collapsed. Private sector involvement is important to ensure that these strategies are economically feasible.

Principle 3: *The enabling environment should assist the FS to detect, assess and address long-term trends that challenge the future resilience of the FS in a way that increases future robustness, including through adaptation or transformation to that trend in the long run.*

To avoid an eroding goals pattern trends should not only be detected, but their potential impact on the future resilience of the FS should be forecasted in order to raise awareness and create a sense of urgency to invest resources in adaptation rather than in the status quo. Only in this way future robustness can be created vis-à-vis the specific challenge including by implementing

adaptations or transformations. As FS actors have insufficient resources to invest in such anticipatory capacity, public-private investment is needed. However, for this also private actors should be convinced of the importance of foresight activities. Communication should be improved not only regarding the challenge but also regarding the potential of possible solutions. An example of this principle has been the consistent approach of the Swedish government towards raising environmental standards in the poultry sector.

Principle 4: *The enabling environment should foster a potential diversity of responses, rather than focusing too much on a limited set of actions strengthening resilience.*

It is important to keep options open and set up learning experiments related to a wide set of structural solutions and this for several reasons. First, resilience thrives with diversity. Second, focusing on one particular strategy may backfire if the strategy turns out to have unintended consequences. Keeping options open and fostering a diversity of potential options does not inherently mean that the actual response should be diverse, as sometimes coordinated action might be preferred. However, the diverse potential of possible solutions should be regarded, rather than only a limited set. This also refers to principle 6, a more systemic in-depth analysis of the root causes of challenges on the one hand, and the vulnerability of the FS to these challenges on the other hand. A too superficial analysis of the problem (or even a deliberate redefining of the problem) can cause blindness for possible solutions.

Principle 5: *The ensemble of the FS and its enabling environment should develop a sufficient degree of ambidexterity, that is, find a balance in putting resources in immediate versus future challenges.*

Since structural solutions require time, there is a danger of underinvestment in such solutions. Therefore, a good balance should be achieved between investing resources in strategies enhancing coping capacity of FS on the one hand and in strategies enhancing responsive (and thus future coping) capacities on the other. Unhealthy patterns are situations in which only resources in coping strategies are invested or when decisions are made without having sufficiently invested in adaptation strategies, such as in the neonics and Brexit case in the UK, because this situation can lead to the shifting the burden problem, whereby the problem return, possibly even more severe. A healthier pattern occurs when the enabling environment provides the right incentives for adaptation, while spending enough resources to overcome temporary income losses following for instance stronger regulation. Examples include the Swedish poultry FS and the French beef FS, where supply chain actors assist the FS by developing quality labels leading to price premiums.

Principle 6: *There needs to be more systemic in-depth analysis of the root causes of challenges on the one hand, and of the drivers of FS vulnerability to these challenges on the other hand, to avoid a redefinition of the problem and the implementation of solutions that don't fix the real problem.*

Often, the identification of solutions to deal with challenges is already largely determined by how the challenge itself, and the reasons for vulnerability to the challenge are defined. Such redefinitions (or too superficial definitions) of the challenge lead to fixes that do not solve the real problem, or only temporarily, and hence lead to archetypes like fixes that fail or to the problems associated with the success to the successful archetype. Advice would be to detect the root causes of the symptoms, which can lead to real solutions that increase farming systems resilience.

6 CONCLUSIONS

Fostering FS resilience is done through (re)designing institutions and building and mobilising resources in order to enhance resilience enabling attributes of FS (and remove resilience constraining attributes). These institutions can be both part of the FS and part of an enabling environment, consisting of private actors (such as food processors, retailers, banks, etc.) and public actors (government agencies). However, an important challenge—both for the FS and the enabling environment—is that some resources are finite: this could mean prioritising the use of resources to build resilience over the alternative use of these resources to support current performance. Therefore, FS and their enabling environments should always find a good balance between addressing challenges in the short run and dealing with challenges in the long run.

We have identified four archetypical patterns according to which challenges are insufficiently addressed to foster FS resilience. We have also formulated six general principles underpinning patterns that enable FS resilience. However, our approach has several limitations, which result from the conceptual and methodological choices we took, including the definition of a FS versus the environment, the scale at which change does or does not occur, the challenges we have identified and the interpretations we made. The principles we propose have been formulated at a relatively abstract level. Task 6.2 of the SURE-Farm project will operationalise these principles into concrete recommendations for all actors involved (FS and enabling environment, public and private) organised into roadmaps at case-study and European level.

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8 ANNEXES



Project acronym: SURE-Farm

Project no.: 727520

Start date of project: June 2017

Duration: 4 years

D6.2: BELGIUM

Work Performed by P2 (KU Leuven) and P3 (ILVO)

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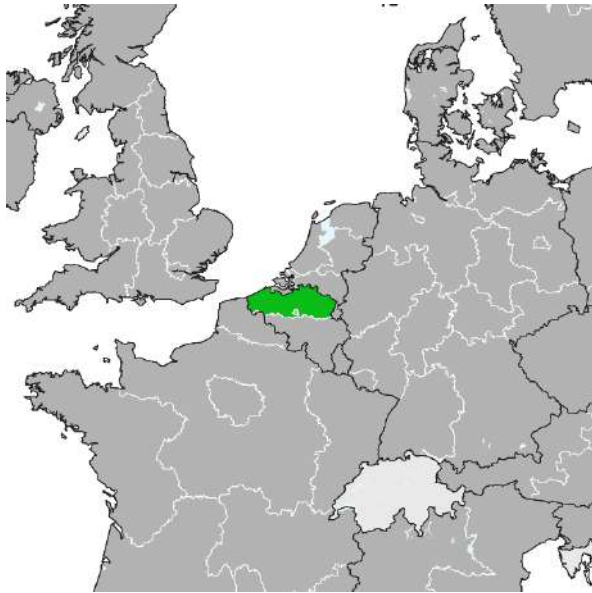
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1 Step 1: Farming system, its enabling environment actors and institutions



The case study in Belgium, is the intensifying dairy farming system in Flanders. Flanders is the northern part of Belgium, excluding the Brussels Capital Region. The region has a population of about 6.5 million, which accounts for 68% of the Belgian population and covers an area of about 13,500 km². Agricultural activities in the region vary widely, with about 12% of the total amount of farms are dairy farms. This system is a particularly interesting case due to the recent dynamics in this sector, with amongst others rapid aggregate and spatial structural change and an increase in total milk production of almost 25% in the last 4 years. The number of dairy farms has

decreased from 9856 in 2001 to 6658 in 2015; while there has been an ongoing increase in the average number of dairy cows per farm. The average number of dairy cows per farm is 55 (Departement Landbouw en Visserij, 2019). Total milk production in Flanders exceeds national self-sufficiency. The market in dairy products is therefore strongly reliant on export.

The farming system's boundaries are mainly determined by the regional boundaries of Flanders. Key actors within the system boundary are identified using the following selection criteria, i.e. the boundary of a farming system is such that we include actors who influence farms, and, conversely, farms also influence these actors. In contrast, actors who influence the farming system, but who are themselves scarcely influenced by the system are included in the enabling environment. Although this mutual influence might not always be that straightforward, it allows a distinction between the farming system and its enabling environment. Key actors (Table 1) in the enabling environment are the government, which includes the EU level policy makers and various regional and more local authorities implementing EU and regional measures aimed at support of the agricultural sector. The AKIS plays an important role, as the farmers rely to a great extent on the services of the well-developed infrastructure on research and extension in agriculture. Within the societal domain, NGO's have an important role in societies' opinion on animal husbandry and environmental aspects related to dairy farming.

Table 1: Actors in the dairy farming system in Flanders and its enabling environment

Actors	Formal institutions	Informal institutions
Enterprise domain: Producer organisations: PO BesteMelk, PO Dairycam, PO Milcobel Input suppliers (feed, technology, fertilizer, pharmaceuticals), banks, insurance companies Processing companies: Inex, Friesland Campina, BCZ Retail	Legislation on Producer organisations Economic regulations, taxation EU cohesion policy	Attitude towards cooperatives Attitude towards retail Commercial relations
Government domain: European level: European Union National level: FPS Health, food chain safety and environment Regional level: Department of Agriculture & Fisheries Department of Environment, VMM, VLM Provinces, Municipalities	CAP, Nitrates Directive Food Law Green Deal, Farm to Fork	Accountability Farmer participation Societal participation
Intermediary domain: Accountancy: Liba, DLV, SBB, MTC Quality assurance and animal health: IKM, veterinarians, DGZ Branche Oranisation: MilkBE Agricultural organisations: Boerenbond, ABS, Bioforum	Futures IKM, interbranch	Ideal form of chain collaboration Ideal farmer type
AKIS domain: ILVO, UGent, KU Leuven, Thomas More, Hooibeekhoeve	Agrolink	Technical vision on farming, best farming practices
Societal domain: BBL, Greenpeace, WWF, Wervel		Societal vision on farming, best farming practices

2 Step 2: Identify challenges and adverse events in the last 10 years

Economic challenges: farmers perceive market price fluctuations and persistently low market prices as very challenging. Milk production in Flanders used to be regulated by the quota. After a gradual decrease of protection measures from 2006 onwards, price volatility increased. Increased milk production after abolishment of the quota (2015), resulted in multiple milk crises. Besides this, low access to land is an important challenge. Competition for land, accompanied with high land prices and low availability of land, makes it difficult to acquire additional land. In a region where scale enlargement is a major strategy to deal with low margins, access to land is a major challenge for many farmers.

Institutional challenges: strict environmental regulations, resulting from the negative impact of the farming system on the environment (GHG emissions, water quality, soil erosion) are also perceived as challenging. Manure legislation in Flanders has become more and more stringent as water quality in the region is still suboptimal. For farmers with a high livestock density, it's often challenging to get rid of manure (increase of costs).

Environmental challenges: Environmental challenges (GHG emissions, water quality, soil erosion) remain a topic in Flanders. One of the main environmental concerns are the persistent extreme weather events. This is mainly resulting from several years of extreme drought which have affected profits in more recent years.

Social challenges are mainly the result of major trends such as intensification and scale enlargement. Farmers perceive low societal acceptance as a challenge. Shifting consumer preferences might also be reflected in demands from buyers and supermarkets in their search for differentiation. Moreover, both growing and diversifying farms are struggling with labour pressure on their farms. Many farmers are dealing with a 'labour dilemma': they should decide to either rely on family labour and/or think of hiring external labour; or to invest in automation in order to be less dependent on expensive labour. Finally, the abovementioned challenges affect succession at individual farm level. High labour pressure, competition with other careers, negative image of the dairy sector, and low profitability all affect the intergenerational renewal at a family farm.

For the response analysis and pattern analysis in step 3 and 4, following challenges are discussed in depth:

Challenge 1: Price drop in 2009 (shock) Because of a combination of supply and demand factors (amongst others, high production because of high prices in the previous year and low demand because of financial crisis and melamine scandal in China), prices dropped to unforeseen low levels.

Challenge 2: Price drop in 2012 (shock)

Challenge 3: Price drop in 2016 (shock) This is the third negative event in the pattern that started in 2007 with higher price volatility and thus the possibility of price drops to very low levels. Again a combination of factors lead to this, amongst other the Russian import ban for agro-food commodities exported from the EU.

Challenge 4: Increasing civil society opposition against animal husbandry in general and dairy farming in general (trend) Civil society organizations increasingly question the use of large amounts of land and other resources for animal husbandry, including dairy farming. The motivations are usually threefold: environmental considerations, foremost the impact of livestock farming in climate change; health considerations following growing food-related health problems; animal welfare considerations.

Challenge 5: Changing consumer preference for vegetarian/vegan diets and plant-based milk alternatives (trend): A growing share of consumers, typically not equally spread in all countries, adopts alternative diets in which dairy products are removed and/or replaced by plant-based alternatives.

Challenge 6: Extreme weather events (noise): During the past decade, and more specifically in 2017, 2018, and 2019, an increasing number of extreme weather events has been challenging agricultural production. The occurrence and intensity of these events varies on a yearly basis, the most influential being dry spells and heat waves during summer.

3 Step 3: Response analysis

3.1 Challenge 1: Price drop in 2009 (shock)

<i>Impact on system functions</i>	<ul style="list-style-type: none"> • Negative impact on farm income (EC, 2013). • No impact on milk production: after 2009, more than 5% of dairy farmers stopped delivering milk (but possibly continued farming), compared to a yearly average decrease of around 3%. Yet, milk production increased.
<i>Anticipation</i>	<ul style="list-style-type: none"> • Lower prices and higher price volatility since the 2003 CAP reform were somewhat foreseen by academic and non-academic market analyst. Globally, a price decrease was forecasted following the 2007 price spike (OECD/FAO, 2008). • Within the farming system, no anticipatory capacity was observed, for most this came as a shock. This could (partly) be explained by low exposure to high price volatility in the past, and to rather low understanding of market and price mechanisms
<i>Coping</i>	<ul style="list-style-type: none"> • EU acted swiftly to remove the shock and increase coping capacity through market measures and income support measures (e.g. direct payments were paid earlier; additional aid package for dairy farmers). Flemish government allowed bridging loans and retail provided temporary bonus on milk price paid to farmer (paid by consumer). • Farmers exhibited some coping capacity by <ul style="list-style-type: none"> ◦ Using buffer capacity (financial reserves, off-farm income) ◦ Using networks and relationships (negotiating solutions with suppliers and banks, possibly including transfer of property) ◦ Savings on costs, early culling, delayed investments, ... • Enabling environment also took actions to improve future coping capacity <ul style="list-style-type: none"> ◦ Research: more attention for price risk management strategies/tools ◦ EU: the High Level Group on Milk was created with the aim of proposing medium and long-term measures to stabilise the internal market and producers' income and to increase transparency in the chain. Their recommendations formed the basis for the Dairy Package that came into force in mid-2012. The Dairy Package lays down rules for the establishment of producer organisations and interbranch organisations, for drawing up contracts and for improving transparency. ◦ Flanders: chain-wide dialogue called 'Ketenoverleg' in 2009, that aims to discuss and take action related to the position of the farmer in the supply chain. The initiative came from an agricultural organisation 'Boerenbond'.
<i>Response</i>	<ul style="list-style-type: none"> • Limited signs of responsive capacity were observed: farming system did not really adapt or transform: no more than marginal changes in production system, marketing system, financing and organisational model • Some adaptations/transformations were observed at the very micro-level, on a small number of farmers, e.g., organic, short supply chains, side-activities. • In Belgium, FAIRCOOP as cooperative was founded in 2010 and launched the 'Fairebel' brand. The objective is to commercialize the total production of the members of the cooperative for a fair price. • Farm exit. The European Milk Board estimated that 3,000 Belgian dairy farmers have ceased their activities since the start of the milk crisis (Vilt, November 2012).

3.2 Challenge 2: Price drop in 2012 (shock)

<i>Impact</i>	Lower prices might negatively impact farm income. However, average family income was not as low as in 2009 and no above average % of farms that stopped delivering milk (EC, 2018).
<i>Anticipation</i>	No anticipation. Rather favourable market prospects were foreseen (OECD-FAO, 2011). However, the report does warn for "A downward correction is projected for dairy prices in the near term, influenced by higher production from major exporting and certain importing countries, the negative demand effects of recent high prices and the uncertain economic conditions in the EU and other developed countries."
<i>Coping</i>	Farmers used their own coping mechanisms (financial reserves, off-farm income, marginal changes to input-output). No specific actions were taken by the enabling environment.
<i>Response</i>	No specific response could be identified

3.3 Challenge 3: Price drop in 2016 (shock)

<i>Impact</i>	<ul style="list-style-type: none"> Negative impact on farm income: below average family farm incomes in 2015 and 2016, but not as low as in 2009. Impact on milk production: in 2016 and 2017, above average % of dairy farmers stopped delivering milk. Yet, milk production increased.
<i>Anticipation</i>	<ul style="list-style-type: none"> This price decrease was only partially anticipated by the EC, despite projected production increases following quota abolition, as the EC expected higher global consumption (OECD-FAO, 2014). The EC expected a small price drop in 2015 with a rebound in 2016. The report did warn for some uncertainties in the dairy markets. Yet, depth and duration of the crisis was not fully foreseen, since additional unpredictable factors (Russian import ban) contributed to this shock. Several actors did show signs of anticipation, because they advocated to control supply (European milk board advocated a Milk Responsibility program (April 2014), private processors explored possibilities for establishing volume contracts and differential price systems for milk delivered over a previously agreed quantity. Farmers seemed less 'taken by surprise'. Higher anticipation capacity might be explained by previous price shocks, with raised attention for market information
<i>Coping</i>	<ul style="list-style-type: none"> Coping mechanisms by individual farmers (financial reserves, off-farm income, marginal changes to input-output). There was a difference in the way dairy farmers have experienced the crisis. As combative as the sector was in 2009, so much resignation was there now. The EU did take actions to remove the disturbance among which voluntary (and compensated) reduction in milk delivery and market measures such as stocks. With the prospect of compensation of 14 euro cents per kilo by the EU, dairy farmers throughout

<i>Response</i>	<p>Europe were stimulated to decrease milk production. 428,000 tons of milk powder were taken off the market to relieve the dairy market, both by the European Union (public storage) as by private players. These last ones receive compensation from the government for the storage costs in order to take their powder off the market for a number of months (private storage) (Vilt, 2016).</p> <ul style="list-style-type: none"> • EU also did take action to assist coping capacity by providing buffer capacity such as sooner payment of CAP-payments. • Bonus on the milk price paid by retail (consumers) <ul style="list-style-type: none"> • Structural changes on individual farms were observed (structural increase in size, associated with more than marginal changes to the production system with more mechanisation, automation and precision dairy farming tools) • Organization of dairy farmers in producer organisations, to increase communication with dairy industry, and to increase bargaining power of farming community • Larger than average farm exit (or at least cessation of milk delivery) was observed • Value chain re-organisation that could lead to adaptations/transformations at farm level: more contracts, labelling and claims, more milk differentiation → reduce probability of future shock/avoid exposure to future disturbance. Some evolutions were observed concerning the use of contracts in the Flemish dairy farming system. Some retail organizations are taking initiatives to set up long-term contracts with individual farmers. • More risk management tools were being made available, e.g. futures through the Milk Trading Company by a private advisory company. • Increase in the conversion to organic farming: a doubling in the number of organic cows for the period 2016-2017 • Investing in more market transparency. The EU Milk Market Observatory aims to provide more transparency to the EU dairy sector by disseminating timely market data and short-term analyses. The Department of Agriculture and Fisheries launched the first dashboards for dairy, providing an up-to-date graphical overview of the most recent price and market information, allowing farmers and sector organisations to respond more quickly to new price and market trends (vilt, 2017)
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3.4 Challenge 4: Increasing civil society opposition against animal husbandry and dairy farming (trend)

<i>Impact</i>	<p>Societal pressure results in higher environmental and animal welfare standards (more strict regulation), leading to higher costs that are not necessarily matched by higher revenues. Farmers state they have higher production and admin costs, and they perceive a negative impact on quality of life (stress, no respect, low self-esteem, etc). Higher environmental standards and restrictions might interfere with scale enlargement and might prevent farmers to operate at optimal scales. At the same time, impact on public functions is mixed: eco-efficiency has definitely improved, but some has been off-set by large increase in production, leading to mixed results.</p>
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<i>Anticipation</i>	This trend has been existing for many years. Animal welfare has been on the agenda for quite some time. Furthermore, the vegan movement has been arguing that milk is not necessary in human diets. Health issues related to human milk consumption have also been debated quite some time. Health issues are very varied, including lactose intolerance and obesity. GHG emissions by dairy cows has been put on the agenda of the public opinion more recently.
<i>Coping</i>	<ul style="list-style-type: none"> • Efforts to remove or slowdown the trend by positive image building campaigns by farming sector to off-set negative images, in sound ways (communicating about progress being made) and less sound ways (discrediting civil society organisations and individuals) - some paid with public resources. Besides this, there is a lobby to delay new environmental or animal welfare regulation, or to lower proposed standards • Mobilizing public and private resources for R&D that improves (or could improve) sustainability of milk production and processing • Investment support, public extension to help farmers implement more environmentally friendly solutions
<i>Response</i>	<ul style="list-style-type: none"> • Limited sign of responsive capacity, the majority of farms in the farming system invest in improving eco-efficiency • Niche innovations into more radically different production systems, often involving short supply chains, other breeds, own feed production, A specific response is the conversion to organic dairy farming, for which European subsidies are available. • Farmers' initiatives to close the gap between farmers and consumers (to reverse the negative image of the sector) • Increasingly environmental and animal welfare concerns are taking into account in marketing strategies. Particularly, pasture based grazing is emphasized. Retailers shift to selling only pasture based milk under their private label: Colruyt (2020), Lidl (2019). Differentiated products are developed to inform the consumer for these efforts.

3.5 Challenge 5: Changing consumer preference for vegetarian/vegan diets and plant-based milk alternatives (trend)

<i>Impact</i>	Not much impact at this moment yet, it is a trend which might become important in the near future. Could reduce income generation function. It could reduce the demand for milk, effects will depend on export possibilities and how responsive capacities in terms of structural change are (farm exits or transformation into producing ingredients for plant-based alternatives, ...)
<i>Anticipation</i>	This trend could be anticipated.
<i>Coping</i>	<ul style="list-style-type: none"> • Efforts to remove or slowdown the trend: positive image building campaigns by the farming sector to off-set negative images, in sound ways (communicating about progress being made) and less sound ways (discrediting civil society organisations and individuals). • Strengthening the sales market abroad where this trend is less pronounced

<i>Response</i>	<ul style="list-style-type: none"> Highly specialized dairy farmers are trapped and may pursue either cost reduction strategies or differentiation strategies to remain competitive. For both types of strategies farmers can obtain EU subsidies (investment, training, advice, etc.). Differentiation, however, is critically determined by the strategies of the dairy processors. Cooperative dairies tend to find it more difficult to raise capital to diversify than private ones. Processors add plant-based alternatives into their portfolio. Large dairies are trying to gain a foothold in the plant based drinking market. Food companies are investing heavily in new brands and products that meet the rapidly growing consumer demand for plant based alternatives.
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3.6 Challenge 6: Dry spell in 2018; dry spell and heat waves in 2019, 2020

<i>Impact</i>	In 2017, 2018 and 2019, long droughts caused water shortages in the agricultural sector. The agricultural sector also faced several heat waves in the summers of 2019 and 2020. The droughts in 2018 and 2019 were officially recognised as 'agricultural disasters'. In 2017, two agricultural disasters were recognised: frost and drought. The impact of drought mainly affects the cultivation and harvest of roughage, both grass and maize. Due to lower yields of roughage, more has to be purchased, which means an increase in feed costs. The heat waves have an impact on the cows. From 22 °C, cows suffer from the heat and will give less milk.
<i>Anticipation</i>	The challenge is anticipated on a regular basis, with the farmers monitoring the weather changes and forecasts. Although the weather is difficult to predict well in advance, the impact of climate change has been known for some time. The phenomenon that we will increasingly be confronted with periods of extreme drought and heat waves is therefore not new.
<i>Coping</i>	<ul style="list-style-type: none"> If a drought is recognised as 'agricultural disaster', government pays compensation for crops that have suffered generalised damage at sector level. Broad weather insurance: since 2020, farmers have been able to apply for broad weather insurances. Flanders contributes up to 65% of the premium. In the future, only farmers who insure at least 25% of their farmland and who suffer exceptional damage will still be able to get compensation for damage due to extreme weather. The government gives subsidies for investments such as collection, reuse of water, irrigation installations, etc. Investments by farmers in projects to save water are increasing. More research money goes to projects that focus on sustainable water use and alternative water sources. Farmers intervene especially at the time of heat waves, by adapting feed management, optimising barn climate, etc.
<i>Response</i>	<ul style="list-style-type: none"> Research shows that the introduction of other roughages might prevent impact of droughts on harvest. However, this is mainly in the research phase, so it is rarely used in practice.

4 Step 4: Pattern analysis

Irrespective of the events (challenges and shocks) as described in the previous section, we observe some general patterns of behavior. We observed attempts both of the farming system or/and its enabling environment to ‘remove’ the shock, to avoid exposure to future shocks and/or to reverse or slowdown the trend. However, measures to deal with recurring events do evolve over time, as the number of similar events increases. For example, for the price shock in 2009, which was the first in a series of price shocks, immediate measures are taken to remove the shock, among which market measures and income support to quickly reduce the impact on farm income. In the case of severe droughts, farmers get paid by the government for their losses. At this stage, immediate coping capacity through providing buffer resources plays an important role to maintain a status quo. In a following stage, additional measures are introduced to reduce the probability of exposure to future shocks. These measures are mainly advocated to increase market stabilization or in the case of extreme weather by investing in insurances. In the long run, we do observe an increase of responsive capacity to adapt or transform to avoid exposure to future shocks (conversion to organic, short chain supply, diversification, labelling, etc). Responsive capacities as such seem to be triggered when mindsets are ready, after a tipping point, which might vary from farmer to farmer. However, the majority of the farmers attempts to increase coping capacity. Triggering responsive capacities might be delayed by the large efforts of the enabling environment to remove disturbance, and reduce the probability of future disturbance just as by supporting coping capacity at the time of a shock.

System archetypes, as defined by Kim (2000) are used to understand the way the system reacts to the above challenges. Archetypes are mainly used for diagnosing long-term problems or events that recur repeatedly in time. Analysis of a series of similar events in a particular timespan might reveal a pattern of behaviour. Archetypes are there to help identify systemic structures that explain these patterns of behaviour. Unravelling the systemic structures that are responsible, might be a good entry point towards identifying high-leverage interventions. In these general patterns of behavior as described above, we distinguish 2 unhealthy patterns which refer to following archetypes:

4.1 Unhealthy pattern 1: Fixes that fail/shifting the burden

This unhealthy pattern can be described as a pattern in which mitigating symptoms prevails over finding structural solutions. In this pattern, a challenge is triggered by a coping reaction in which the enabling environment provides external interventions to mitigate the symptoms generated by the challenge rather than providing a structural solution to the challenge (fixes that fail).

Moreover, such interventions may produce a side-effect that undermines the structural solution in the long run. Both series of price shocks and extreme weather events do fit this pattern (Figure 1). With respect to the extreme weather events, the enabling environment—primarily government—frees up reserves to pay out farmers for income losses or provides subsidies for investing in weather insurances. When government keeps doing this unconditionally, farmers have no incentive to invest in solutions in which they adapt towards a system that is less exposed to these events. Reactions to price shocks also seem to fit this pattern well. For instance, the 2009 milk price drop was by most in the Belgian dairy farming system regarded as a shock, even though it was part of a trend where dairy farmers in most of the EU became more exposed to price volatility than before, because of larger participation in the world market against which they were less protected after the CAP reform. Farmers exhibited some coping capacity by using buffer capacity (financial reserves, off-farm income), networks and relationships (negotiating solutions with suppliers and banks, possibly including transfer of property), savings on costs, early culling, delayed investments, etc. The enabling environment acted swiftly to increase current coping capacity, mainly through mobilizing public resources, that is, market measures and income support measures (EU), bridging loans (Flanders) and a temporary bonus on milk price paid to farmer (paid by consumer via retail). At the same time, limited signs of responsive capacity were observed, the farming system did not really adapt or transform. Actions are primarily taken by government, based on the financial reserves they can mobilise or the amount of leeway that exists to temporarily change certain regulations. However, as these are symptomatic solutions instead of fundamental solution to the problem, price drops recur in 2012 and in 2016. Although we do observe a shift towards more responsive capacity in the farming system as crises succeed each other, supporting coping capacity by the enabling environment might slow down investing in it. This pattern of behaviour might largely be explained by the vested interest both by the farming system as by its enabling environment in maintaining status quo and safeguarding sustainability of milk production by the farming system. However, farming system actors rely very much on actions and interventions by government, which is illustrated by the manifestations both in 2009 and 2012, when litres of milk were thrown away to force measures from the government to support them during these crises.

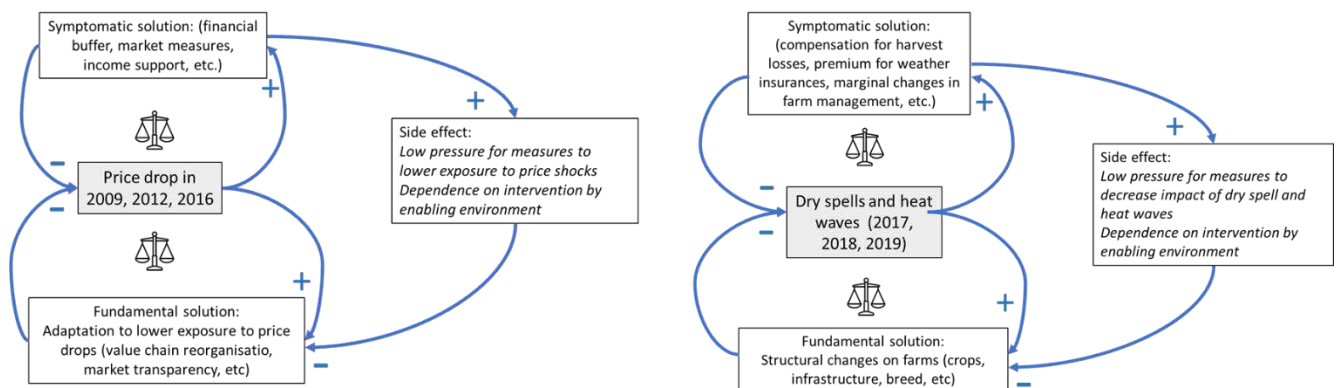


Figure 3: schematic overview of ‘fixes that fail’ pattern of behaviour related to price drops and extreme weather events in farming system in Flanders

4.2 Unhealthy pattern 2: Eroding goals

A second unhealthy pattern observed, relates to the archetype of eroding goals. In this archetype, a challenge creates a gap between a goal and the actual condition. Rather than taking actions to improve conditions, actors adjust the goal (e.g. downplaying the challenge, redefining or reinterpreting the problem differently) in order to justify lack of action. The pattern not only involves a lack of anticipatory capacity (by not adequately picking up a challenge), but also the deliberate actions to try to remove or mitigate the challenge itself. A typical result is shifting the deadline of reaching a goal to delay action or in the hope that the problem will “go away”. The danger is that this pattern results in a situation that ultimately cannot be solved anymore (that’s why it is often referred to as the boiling frog archetype). This pattern is clearly observed for the trend of increasing civil society opposition against animal husbandry and dairy farming just as increased consumer preference for vegan (Figure 2). This trend is based on environmental, animal welfare, and health reasons. This trend is present for quite long, whereas initially meat was more targeted, recent years have seen a large increase in opposition and now also milk has become a target. Efforts of the farming system and enabling environment mainly focused on removing or slowing down the trend. Examples include positive image building campaigns to off-set negative images, in sound ways (communicating about progress being made) and less sound ways (discrediting civil society organisations and individuals) and lobbying to delay new environmental or animal welfare regulation, or to lower proposed standards.

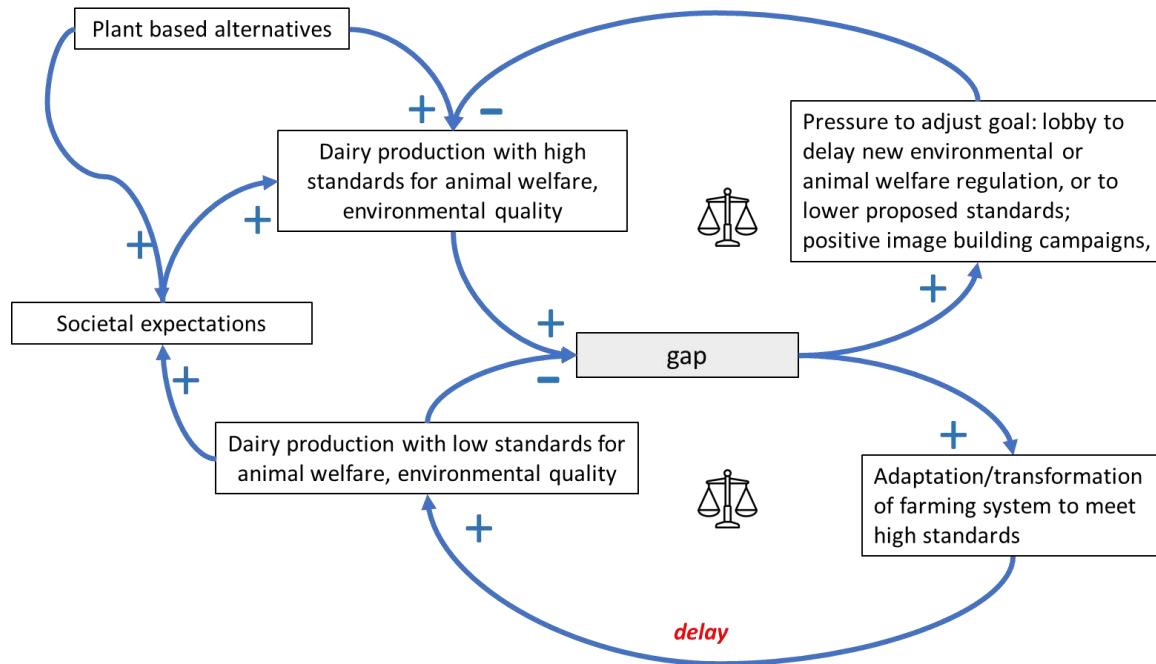


Figure 2: schematic overview of ‘eroding goals’ pattern of behaviour related to increasing civil society opposition against animal husbandry and dairy farming

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D6.2 BULGARIA

Work Performed by P14 (UNWE)

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1 FARMING SYSTEM AND ENABLING ENVIRONMENT ACTORS AND INSTITUTIONS

Crop production is important and has long tradition in Bulgaria. North-East Bulgaria, where the research area is located, is known as “the granary of Bulgaria”. The relief is varied with semi-mountainous areas, river valleys and lowlands. The climate is with well-defined four seasons. And the soils are among the most fertile in the country, suitable for growing of cereals, sunflower, industrial crops, fruits, vegetables. The agriculture (in particular grain production) is a key agricultural sector. It is considered of crucial importance in regard of the cultivated land and level of production. The agricultural land on average amounts to 80-82% of the total area of the region and represents over 1/3 of the total arable land in the country. The share of the CS region in the total crop production of the country is stable during the years and for the main crops is as follows: wheat (45%-50%), barley (40%-45%), maize (50%-55%) and sunflower and rape (40%-50%).

North-East Bulgaria is well-developed agricultural region as the production capacity is result from the natural conditions on the first place but also from the historical developments and transformations which had taken place. In this regard several facts have influenced the farming system formation as well as the involved actors and institutions and the enabling environment: 1) Agriculture during the communist regime (1944-1989) was organized in large-scale, mechanized farms (over 92% of arable land belonged to the collective farms - complexes averaged between 36,000 and 100,000 hectares). Specialisation (horizontal integration achieved by specializing in several crops and one type of livestock) was externally forced not only for the production units but also for the regions. North-East region had specialized in crop production with main field crops wheat, maize, and barley. Today, these developments have been considered as a tradition. 2) After 1990, the large production complexes are dismantled; the property rights in land returned to their initial owners prior to collectivization (resulted in highly fragmented agricultural land). The sector has passed through a rapid transformation and the private farms (either family, cooperatives and corporate) emerged and developed last 25-30 years. 3) After the year of 2000 – the period of preparation to and accession to the EU (2007) – the process of CAP implementation has changed farmers’ behaviour as well as the interest in farming and land relationships (characterised by higher competition and restricted access to the land, land prices (rent and lease as well) increased several times (up to 10 times)).

Thus in the studied farming system the main actors (Table 1) we identified are the arable farms: large-scale (above 1000 ha of arable land) mechanized farms, specialized in the production of grains, maize and sunflower, which have been gradually developed into their current form in the past years as explained. Those farms directly influence and are influenced also by other farm types

such as livestock farms, farms with perennials, vegetable growers, beekeepers and arable farms with smaller size; as well as land owners and farmers' households. The other actors who influence the farming system but who are themselves scarcely influenced by the system include:

1) policy makers (agricultural, investment, food policies). Policy makers and policies influence farms and the system as a whole at a high level. At some extent in the case of large-scale crop production and the place of the CS region there is an influence on the policy-makers as in general larger farms have higher level of influence on these actors compared to the rest of the farms. The policy makers should provide stable and stimulating environment part of which is clear long-term national strategy in agriculture which to be followed consequently and decrease of the bureaucracy and administrative hindrances.

2) suppliers (machineries including maintenance and additional services provision, seeds, fertilizers, pesticides etc.). These are among the most influential actors on the arable farms. At national level the competitiveness between supplier actors is high which puts farming system in better position.

3) Wholesale buyers of agricultural produce and export markets (grain is traded internationally and markets developments are important since Bulgaria is a country price-taker). In general framers are not in favourable place within the supply chain and at international level they do not influence the markets. The case study region is on the border with Romania and Romanian market influences the price levels mainly for fruit and vegetable producers. Additionally, for grain market the influence of Ukraine and Russia is high at inter-regional level.

4) Financial institutions (banks, insurance companies). The trust between farmers and bankers increased during the years. Today, also having in mind the security of EU support, made bankers more open, collaborative and supportive to farmers. Currently, for the farms it is easier to secure sources of investments. The relationships with insurance companies are still limited and there is a need of time to build trust. The main role should be to the insurance companies looking for innovative, informative and better targeted agricultural insurances.

5) Local government and administration which are very important in their role to down scale and implement national policies according to the specific conditions of the region. But also as a main player in solving the overall negative trends in rural areas because they cannot be solved by a single farmer. The complex and simultaneous actions are needed in different scopes and coordinated by governmental institutions both at national and regional/local level.

6) Educational, research and developments units (knowledge and technology providers) including advisory services providers.

7) NGOs in different roles: LAGs are important as local player implementing local strategies for development and offering additional opportunities for farmers' investments; producers' and branch's organizations which still are underdeveloped but should champion farmers' interests; ecological NGOs.

8) Consumers and local communities. It includes common actions and participation in local life, acceptance by locals and support given to/by local community in reward. For large-scale farmers it is important to build good image and to be leaders in their local community. It is a precondition for success related to the trust and willingness of locals to work for and together with them.

All of these other actors are part of the enabling environment of the studied system and are presented also in the Table 1.

Table 1: Actors in the Bulgarian crop farming system (large-scale grain production) and its enabling environment

Actors	Formal institutions	Informal institutions
Enterprise domain: Farms Cooperatives Machineries/Input suppliers Traders	Corporate companies Cooperatives Trade companies	Economic relations Low level of cooperation Decreased trust in cooperatives as production entity
Government domain: European Institutions Ministry of Agriculture, Food and Forestry and its regional and local offices Ministry of Environment and Water and its regional offices Local governments LAGs	CAP (greening) EU regulations and directives GAP implementation National laws in agriculture, food and environment Taxation	Accountability Decision making Farmers' representation Societal participation
Intermediary domain: National Agricultural Advisory Services Producers' unions and associations Private consultants Banks/Insurance companies	Public institutions Private organizations Individual companies Specific credits and insurances	Informal cooperation and negotiations between farmers Farmers negotiating power increases within the supply chain Credit risk acceptance Long-term relationships increase trust and access to financial resources
AKIS domain: Educational and research institutions NAAS Pioneering farmers Technical consultants and representatives of global companies	Schools Universities Research Institutes Private companies Associations Media	Innovations and technology perceptions and acceptance Farmers knowledge exchange Increased awareness about natural resources preservation

Specialized agricultural press		Acceptance of climate changes and need for common actions Weak relationship with educational and research institutions
Societal domain: Farm household Land owners Other farmers Local communities (Social media) Consumers Internet magazines	NGOs LAGs Citizens	Society perception on farmers' activities and farming Land possession and economic realization of ownership Environmental concerns Consumers preferences

2 IDENTIFIED CHALLENGES AND ADVERSE EVENTS IN THE LAST 10 YEARS

The crop farming system (with focus on large-scale family and corporate producers) in Bulgaria faces following challenges classified in the four main dimensions:

Economic. The challenges are summarised in two main categories:

1) *Price volatility (noise)*. The long-term development of prices is determined by various trends, e.g. increasing global demand for raw materials, development of new markets such as biofuels, changes in consumer preferences etc. In case of crop producers in Bulgaria, the farmers are price-takers since the price levels are directly influenced by the fluctuations (increases and decreases) of international grain markets. The price levels up to 2015 has been stable and increasing. After that the prices on the international grain market have been falling and this has reduced net farm income by about 20%. For example, the price of wheat for that period registered a decrease of about 15%. Another important fact is the price transmission between the different levels of the food supply chain. Thus, the average values of price asymmetry in the grain-flour chain shows high levels and lack of price integration. But the farmers are exposed on the negative changes not only on the output markets but also on the input markets. After the country's accession to the EU there is a clear trend of expenditures increase in agriculture. The cost index of total production costs for the period increased by 15%-20%. The largest fluctuation is registered for the prices of fertilizers.

2) *International markets and competition (trend)*. The overall index of competitiveness for grain production in Bulgaria is high. Grain production is not only an important and strategic sector at national level, but it has a good position on the global market. The unstable market developments over the years force the sector to invest continuously to adapt to the global market conditions. The both challenges require additional and specific knowledge and experience in analysis and understanding both trends. The political instability in the world as well as the decisions like

Russian embargo (and possible trade regulations by other world players) also represent challenges which affect markets.

Socio-demographic. Two major challenges emerged here.

1) *Lack of labour force (trend).* The trend for depopulation of rural areas (lower level of income and services compared to urban areas is a main driver of migration processes) inevitably interconnected with population ageing which leads to lack of skilled labour force both for field work and managerial staff in the farm structures. The process interrelates with the difficulty to find and engage young qualified/skilled workers and specialists exaggerated by the weak relationship between research and educational institution and the business structures in agriculture. Thus the performance and outcomes of agricultural activities (entrepreneurship, changes, ambition for novelties/innovations, etc.) are predetermined.

2) *Consumers' preferences (noise).* The second most important challenge that was identified is the need to respond to consumer' preferences and changes towards increased demand of local and environmental friendly production. Additionally, consumers trust in nationally produced food was eroded for many years by the low quality and need to be addressed taking into consideration the cost price of food, because it affected the affordability for the consumers.

Environmental.

In the case study region, *the extreme weather conditions (droughts, hail and floods) and climate changes (noise) like extreme temperatures both summer and winters* are major challenge for crop producers affecting production technology (processes), yields etc., especially occurring in crucial moments for the production process. Many farmers accept those conditions and changes as part of the business and start to look for adaptations to overcome them since the intensity and the occurrence of the negative events increased year by year. The strong negative impact on the productivity is identified because most of the extreme changes are controversial and extreme for the cultivated varieties and cultivation technologies used. It also leads to negative effect on net farm income in general. Despite positive exceptions are observed in years, in which cereal crops have obtained lower yields but their selling prices have gotten higher prices. The *drought in 2020 (shock)* is the most recent climatic event which effects on the production output put many grain farmers on the limit to go out of business. The drought happened during the vegetation and reduced the yields and the overall harvest, respectively the income by 30%-50%, at every farm in the region.

Next, *the preservation of natural resources (soil fertility) (noise)* is considered an important challenge. The crop production in North-East Bulgaria is a monoculture very intensified farming

which is considered damaging for the soil fertility and other natural resources. Farmers should strictly follow good production practices including crop rotation to ensure long-term preservation of production capacity of the land. Moreover, they are forced to introduce agri-environmental production practices as part of the policy greening requirements. In this regard, farmers must also comply with regulations (parts of the region are designated nitrate vulnerable zones and for all type of farms and specialisation impose restrictions) in order to prevent underground water and air contamination as well. Most challenging is the fact that not only the change in technology is required imposed by regulations but also it is linked with farmers' long-term understanding of value and importance of natural resources and proper production practices. It requires new knowledge and understanding of the processes and natural resources management.

Institutional and political. Main issues identified in this regard are: *constantly changing policies and regulations (trend)* and *land ownership and their regulations (trend)*.

The policy challenge encompasses both changes in the national policy and in the EU policy which implementation in the country is still quite unclear for the programming period after 2021. The uncertain situation in policy domain prevents long-term planning, especially in case of the investments in the sectors outside of crop production and sectors where the biological processes are longer (e.g. fruit-growing, animal breeding etc.). Crop production investments, compared to the other types of production, are the most acceptable and could be changed (even machineries could be used in cultivation of other crops) when changes are made on a short-term basis.

This short-term planning is reinforced by the fact that large-scale farmers rent the majority of the cultivated land (approximately the share is 50% at farm level) and landowners prefer to enter into short-term contracts expecting better level of rents from year to year. Hence, the rent levels (as well the land prices) increased enormously. Moreover, these relationships are impeded by the land fragmentation. The land relationships regulations at the moment do not specify any stimulus/penalties to trigger the land consolidation and long-term security for farmers for who the main production factor is the land.

3 RESPONSE ANALYSIS

The response analysis is presented for each specific challenge and includes: the potential and actual impact, the challenge anticipation, the challenge coping and the response of the studied farming system.

Price volatility (noise)

Impact (potential and actual)

Price volatility is one of the main economic challenges that farmers (and any other actor in the farming system) face. There are many factors which influence and may intensify these fluctuations. The analysis acknowledges that both prices of the outputs and inputs should be taken into consideration. The expectations that after 2007 (when Bulgaria joined the EU) the costs of rent, employees, seeds, fertilizers, and chemicals would increase have been confirmed. The prices of these products have increased also internationally and from 2015 onwards it is especially in the price of fuel and fertilizers. The potential and actual impacts are negative for the farm production costs, respectively to net income (the economic viability of the farms and the private functions of the system). There is a consensus that the changes in food prices have also many negative impacts both in the short and the long-run. In this regard unstable output prices influence again the farm profitability and consequently the level of wages and the security of working places in the sector. Thus, the private functions like ensuring a reasonable livelihood and improving quality of life in rural areas are negatively affected. In general expectations are that the increase of the world populations would increase the demand to which farming system in general could not respond. Therefore, farmers in North-East region assume that the output prices will not drop off drastically and the natural conditions would be in favour to their activities.

Anticipation

Currently, farmers see price volatility as a very risky issue which depends on the world market trend as well as different political trends (e.g. Russian embargo and more general to say political risk which has nothing with the market but with the global conflicts between countries and blocks). The farmers' role in this situation is limited. The anticipation of this challenge is clear and farmers accept their limited ability to control/influence the grain prices (commodity/stock market), they just follow the world/regional trends. The question about anticipation is related to the uneven spread of the power between different actors in the value chain as well. The grains are stock products and usually the farmers do not have capacity to trade directly on regional/world stock exchanges, they are forced to use traders and middlemen. This is the point that farmers do expect regulation by governmental institutions to equal their positions.

Coping

There are many actions that farming system actors undertake to cope with the price volatility in collaboration between the farmers themselves and with advisors and consultants from the trade companies. The improvement in planning and of financial management of the farm including

optimisation of costs, profits and money flows (taking into consideration the seasonality in grain prices and the need of extra efforts and costs for storage), make farmers more confident and independent in the process of negotiations. Next, improvement of farmers' knowledge and understanding of the stock exchange functioning and gaining knowledge and experience with international markets, help farmers to better use different market instruments (e.g. futures etc.). It is also very important the access to the information about the grain prices (markets) from trustful sources which gradually improved with implementation of the ICT which is one of the most important role of the associations and unions in the sector.

Response

As described price volatility is challenge which requires continuous efforts and it could not be eliminated. On the contrary it is expected to exaggerate as a result of changes into production caused by climate changes and natural resources conditions. Therefore, crop farmers invest in new technologies (some of them regarded as adaptations since change the system functioning) for production costs' optimization and expand their capacities for storage (part of the robustness behaviour). Moreover, there are actors within the system who look for transformations investing in new businesses (e.g. transportation, processing) to decrease the dependence of the output price volatility.

International markets and competition (trend)

Impact (potential and actual)

In Bulgaria still the stock exchanges have limited activities (e.g. hedging is not applied or is limited) and there is no correlation/interrelation with Bulgarian and the nearest European stock exchange, Euronex. Thus, at national level farmers miss better marketing infrastructure for cereals (even the lack of infrastructure because Bulgarian ports cannot handle the cargos and cannot deal with the logistics) and are very much influenced by the international markets. Moreover, the grains are world traded products and the competition at this level is very high and intensive. It is difficult for a single farmer to compete on the world market but every one of them follow the trends. The impact of the international markets developments is controversial and in the highest degree is the same like the price volatility challenge in negative terms. The positive impact is on the pursuit of better competitiveness which affect mostly the private functions of the farming system. But there could be also a positive effect on the public function of preservation of natural resources and biodiversity as result of improved technologies and high level of smart decisions implementation.

Anticipation

The farming system actors anticipate this challenge taking into account that some of the developments of those markets are based on the political decisions and are not driven by the market and economic logic. They recognize the main competitors in grain production and markets: Russia, Ukraine and the invasion of the markets in the Black Sea region and the Arab world, follow the progress and adjust their behaviour accordingly.

Coping

Marketing strategies to sell in different periods (expanding capacities for storage) of the year and to collaborate on long-term basis with the middlemen and/or representatives of world trade companies are the main actions farmers undertake to cope with the challenge. Improvements in the knowledge and market risk management is also applied. The price volatility and international markets challenges are interrelated and from the perspective of actors and institutions involved are restricted to meet the international trade agreements and the free movement of goods in EU as well as the principles of the common organization of markets in the grain sector.

Response

The challenge itself stimulates farmers' adaptation affecting farmers' decision making and the acceptance of new technologies (e.g. precision farming, GPS control etc.). These novelties are highly appreciated and farmers realise that the increase of their efficiency (decrease in production costs) is the only way to keep and advance in international competitiveness.

Climate changes (noise)

Impact (potential and actual)

Climate changes are very tangible last years. Droughts during the vegetation and heavy rains (often even hailstorms) during the harvesting times are the most challenging weather conditions for crop farming system in the North-East Bulgaria. The positive impact is always possible but as a challenge the negative once is considered and discussed. The negative impact of climate changes is defined by the severity of droughts and rains which directly influence the productivity levels. In combination with negative fluctuations in output prices, the farm economic profitability is decreasing. Hence, all the private functions could be affected, e.g. decreased production of healthy and affordable food products as well as resources for the processing sector and decrease in the farmers' income and in the quality of life for everyone working in the crop production. Additionally, the bad weather conditions could be followed by diseases (and/or insects' invasion) which requires additional actions to be undertaken. The production costs would increase but these actions could be damaging for the natural resources and biodiversity. The negative effect of the climate changes jeopardises also the delivery of public goods.

Anticipation

The climate changes challenge (both as a clear tendency of the future and as shocks like the drought in 2020) is anticipated by the system actors. Farmers are absolutely aware and improve their equipment with information and instruments for local observation and prediction of the weather. They are working closely with their colleagues, suppliers and researchers. The anticipation of climate changes is the main stimulus for better collaboration with research and innovation institutions to experiment, test and implement according the local conditions new technologies and varieties. It is also positively influenced by increased interest in insurances. Farmers became more and more aware of the insurance options and insurance companies are more open to offer insurances in respect to the specificities of the crop production.

Coping

One of the most important step that is needed to be undertaken is the restoration/renovation and maintenance of the irrigation system (there are possibilities because in the past 80% of the fields were irrigated) as recognized by all the stakeholders. There are a few farmers which started the process but it is affordable only at regional and system level (some would say even at national level). But the irrigation is a partial solution in long-term perspective because the climate changes are more complex. Therefore, many farmers undertake additional activities like cultivation of drought-resistant crops, introduction of new varieties (most of the interactions in this regard are with the big world companies), strictly follow crop rotation, new land processing systems implementation (no-till, strep till technologies), better machinery equipment to lower the dependencies from the weather, territorial diversification of the plots etc. One of the coping strategies undertaken by several farmers actively involve research and scientific institutions. It is increase and produce national crop varieties since their resistance is higher even in bad weather conditions, especially for diseases. Each one of the mentioned activities initiated by the system actors requires proper knowledge and practical experience of the farmer as well as his/her ability to manage the production process. The climate conditions even without the changes vary year by year and if the farmer is skilled enough he could make right decisions (except in case of disasters). The bigger issue is the quality of the implementation/performance of his/her decision where important roles is given to the advisors and consultants.

Response

Farming system responses very quick to the climate changes. This is one of the challenges (together with the lack of labour force) which in the highest degree stimulates system adaptations and even transformations. The so called conventional technology (monoculture, highly intensified) causes tensions for farmers to succeed in proper cultivation/treatment of the sown

fields at the right time because of limited machineries and appropriate weather conditions. Further steps/support should be taken at national level by the state authorities to recover and develop institutes for crops selection and production of Bulgarian varieties of seeds. The above described strategies undertaken by the actors at this moment tend to change these elements and processes in the crop farming system and still preserve its ability to deliver private and public products and services.

Preservation of natural resources (soil fertility) (noise)

Impact (potential and actual)

The preservation of natural resources is a fundamental in agricultural production. Generally, the production capacity of the natural resources (especially soil) is limited according to the biophysical and geographical circumstances and factors. It is impossible to increase inputs limitless (chemical inputs as a whole and fertilizers in particular). The soil fertility preservation turns to be of key importance in crop production. It directly affects any function provision of the system, either private and public. It is a precondition for the plots productivity, farm profitability and economic viability of the crop production. There is a turn point where to keep (in some cases increase) the yields there is a need of change the technology/varieties. Moreover, in combination with the climate changes, e.g. too high level of rain, soil fertility could be compromised and negatively impact plant health and biodiversity. Thus, preservation of other natural resources and biodiversity would be taken into consideration as well when soil fertility preservation is aimed.

Anticipation

In the last century great changes have taken place in the crop farming system in the North-East Bulgaria. The focus is on large scale production and strongly mechanized agriculture with high use of inputs. This attitude towards nature and natural resources utilization proved not to be proper and it causes negative effects in long-term in regard to the capacity and potential for crop production. There is a general consensus that nature causes the highest risks for farmers. Despite of the weak and slow speed the tendency about the new role of agriculture and the need of change toward more sustainable development is anticipated. In the process farmers are important but also 1) the state authorities – the control on pesticides and herbicides is needed because the negative effects are spread out and sometimes it is not so important what the farmer does but what the neighbours do; 2) research and scientific institutes working in collaboration with farmers, state authorities and input producers; as well as 3) the non-governmental sector which role is very important in warning, educating and training about the value and importance of the nature.

Coping

The coping strategies relevant for the sustainable land use are implemented. The introduction of green payments, as well as the requirements for crop rotation and inclusion of protein crops are acknowledged as having positive effect on soil fertility as well as changes in tilling technology.

Response

Despite preservation of the soil quality may support the robustness of the farming system, in combination with other challenges it stimulates implementation of adaptations of the crop production. But these processes require also institutional intervention including regulations on the land relationships and production technologies as well as stimulation of the science-practice relationship for better land management.

Constantly changing policies and regulations (trend)

Impact (potential and actual)

Any of the crop farming system functions is affected by the inconsistent decision-making in policies and laws and the low level of trust both in institutions and policy makers accumulated during the years. Instability and sometimes contradictory decisions and changes into the regulations stress farmers' daily work and limit their long-term plans. The administration's reactions are in general slower compared to the speed that process in production happen. But both private and public functions maintenance require consequent and coordinated actions taken on time. The contradictions between different legislation put farmers in a position to break the rules and/or could oppose crop farmers to the other farmers or even local community. For example, crop farmers have to inform bee-keepers for use of chemicals but according the GDPR legislation they could not have access to the personal data of beekeepers – phone numbers and emails to manage their arrangements. The productivity of the plots close to the beehives may be compromised if proper treatment is not done. If the treatment is not announced ecological issues could rise.

Anticipation

At farming system level this challenge is accepted. For the single farmer it is more stressful and costly to manage the contradictions and to follow the changes. Therefore, for the single actor the level of anticipation is lower except in the case of the periods for programming related to the budgetary planning at EU level. During that period farmers are aware of the changes and always their actions in cooperation with producers' organizations and NGOs, strive to lay better foundation for the next years.

Coping

There is common agreement that agricultural production and food sufficiency is part of national security and it needs to be prioritized in national strategy developed by the ministry. Better collaboration between farming community and the experts and policy makers unable the process of understanding farmers' problems caused by the ever changing legislation and policies. Part of the coping strategies is organization of information channels (online publications, institutional webs, seminars, info-days etc.) to better informed farmers about the current policy, to stimulate their participation in the agricultural policy development/implementation. The key role in these strategies is given to the producers' organizations/associations, consultants and ministry which plays the important role to coordinate structures and ensure flexibility in supporting the sector.

Response

A major response in regard to this challenge are the changes in the actors' behaviour and the increased presence of the NOGs in monitoring crop producers' interests, supporting policy makers, providing consultations and technical support. A big step forward is the changed perception that agriculture activities relate only to the agricultural policy. Cooperation and coordination of the other policies relevant to the sector is among the most important responses especially in the field of labour, ecology, insurances, taxes etc. The improvements in rural development policy targets and implementation towards keeping the people in the villages also is in line of better response to the challenge.

Land ownership and their regulations (trend)

Impact (potential and actual)

The historical developments led to land fragmentation and increased level of competitiveness for land and level of transaction costs (especially after SAPS are introduced). The impact is negative in sense of increased production costs for farmers not only because of increased levels of rent and land prices but because the parcel fragmentation and distance from main farm premises increase the organized transport for the machineries, production, fertilizer, etc. Inevitably the economic viability of farms is lowered as well as the ability to ensure reasonable livelihood for people involved in farming. The challenge affects also the food production function because short-term contracts preferred by the landowners does not stimulate diversification and cultivation of other crops instead grains and oleaginous. For public functions it is also not favourable situation because land ownership is considered one of the reasons for monoculture structure dominating the region agricultural production (it decreases soil fertility). The short-term

rent contracts make difficulties for farmers to ensure crop rotation (which increases the use of inputs) when farmer is forced to change the cultivated plots on yearly basis.

Anticipation

Farming system actors as well as the land owners, farmers' associations, state authorities and research institutions are aware of the problems of land restitution as a technology and way of implementation. The fragmented ownership and complicated land relationships are anticipated by all of them. Despite often legislations changes are undertaken the problem still exist. Even it is considered that radical change is needed to force land consolidation and transparency of the ownership, part of which is the organization and functioning of the land market.

Coping

One of the main coping strategies farmers use is the non-formal negotiation between them within the framework of the current legislation. They also are very active in networking creating social links with locals (active support of local development) and building up trust in land owners to ensure again on a non-formal base long-term negotiations with them. From all actors involved in the process farmers are the most active as the landowners the less. In between are the farmers' associations which act at national level to unite different interests of farmers from different regions and represent them in a legislation building process. From the governmental point of view, the actions undertaken are in the direction to keep the social peace balancing between the interests of owners and farmers.

Response

One of the main responses is robustness in production specialization of the farming system investing in annual crops cultivation. Adaptations are observed in the production technologies and varieties used. The investments in land acquisition and in machineries for multiple use is another response to this challenge.

Lack of labour force (trend)

Impact (potential and actual)

The main impacts are related to the private functions delivered by the crop farming system. The lack of labour results from the bad living conditions in rural areas compared to the urban (e.g. even some of main infrastructure and services are missing, such as schools, kindergartens, healthcare, etc.) and the lower economic realisation. But the lack of labour deepen these problem in a vicious circle. The lack of labour negatively impacts also the diversity and quantity of food

production since farmers are limited to the products which require less labour and/or which cultivation could be mechanised to replace the labour. The limited number of educated young workers has also negative effects on the farms' profitability since innovations implementation is also difficult and it requires additional investments. The production expenditures also increase having in mind the competitiveness for workers and increased levels of labour payments. The latter has a positive impact on the overall improvement in the quality of life in farming areas by providing employment and decent working conditions.

Anticipation

The overall socio-demographic developments in the country continue to be negative and current studies and assessments for the future are not optimistic. The labour factor is crucial and it is obvious that current status of the rural population suggest that in next years the lack of qualified workers will be even more sharp than now. Even now farmers struggle to ensure workers for timely operations. Farmers and system actors (I would say everyone does not matter if is an actor in the studied system) accept the reality and many of them think out to bring employees from abroad (countries outside EU). Farmers undertake actions to examine the legislation possibilities, requirements and administrative procedures to make it happen. The challenges in hiring foreigners are many including labour laws, working conditions restrictions but also farmers should additionally invest in the accommodation and transportation of the hired workers.

Coping

In coping strategies farmers are the most active despite overcoming the negative trends to require complex and very targeted activities from all the stakeholders, especially governmental institutions. Farmers invest in new technologies, modernization and oriented their production towards crops where the processes are easier to be mechanized. A very important step is the cooperation with educational institutions again initiated by the farmers who started different scholarship and trainee programs. Many farmers also stimulated and invested in the education of their children as potential inheritors of the farms and they study and participate in internships abroad. The supplier companies and NGOs are also involved through organization of different trainings and open days to raise awareness about opportunities in agriculture, improvements in the sector and its importance for the society and the nature. Part of the coping strategies are undertaken by the government through investments in the rural areas to increase their attractiveness.

Response

The main responses are adaptations of the production according to the new realities and investments in qualification and education of the human resources. Important are the responses and the role of specialised schools and universities which improve their programs to enrol (increase the interest in agriculture) and motivate young people to continue their career in the sector.

Consumers' preferences (noise)

Impact (potential and actual)

Food, and its nutritional value, are of key importance for human health and well-being. The grain group, including breads, are among the four food types groups determining the food diversity and balance of nutritional elements. The consumption of cereals is old as human history. But the consumers' choice is always influenced by different factors which change consumer behaviour as well, such as social norms, concerns about environment and production methods (in agriculture but also in processing of food), food safety and security, food wastes and losses, concerns over health etc. Currently all actors to certain extent are aware about these changes, especially in case of world pandemic situation. The impacts on the studied crop farming system may be controversial. From one side it is sure that the system should change to produce more safety products with high quality applying environmental friendly practices which has a positive effect on the provision of private (healthy food products delivery and improvements in people's well-being) and public functions (proper maintenance of natural resources and biodiversity conservation). On the other side, the farmers will be forced to invest in innovations and preservation of high standards which increase production expenditures. Combined with unfavourable market conditions it could decrease profitability and economic viability of the farming system.

Anticipation

There is a certain extent to which farmers anticipate this challenge since they have started to look for information about new trends in cereals consumption like about consumers' benefits of chickpea consumption, for example. Their main goal is to adjust the crops variety according to these preferences, like cultivation of those suitable for preparation of ready-made foods or cereal-based foodstuffs, breakfast cereals and high fibre, grain-based foods. The anticipation is part of the efforts farmers put in higher responsibilities to the society. All actors from business, governmental and non-governmental organizations anticipate this challenge, but during the study evidences for isolated and single actions from their side were identified. The supply industry invests in research and development of less damaging inputs for the agricultural production.

NGOs champion the environment and human health. At governmental level (based on the decisions taken at EU level) measures in the “farm to fork” strategy are envisaged.

Coping

The coping strategies farmer undertook up to the moment relate to high degree with the strategies undertaken to overcome or benefit from the rest of the challenges, e.g. innovations implementation, environmental-friendly practices application, lower level of inputs etc. Specific action is the investigation of the market opportunities and main competitors in the production of the alternative crops, e.g. for chickpea the market is very sensible, since the main export is for India and Pakistan and two years ago the production level is good in India and the prices decreased.

Response

The main response is adaptation which allow farmers to improve the care for soil fertility and preservation of natural resources. Additional efforts are needed from the processing industry to prepare a market-driven identification of appropriate new products. Important part is the response of governmental bodies because legislation changes are needed such that would give Bulgarian products an advantage and efforts to strengthen the image of Bulgarian products among consumers in the country.

4 PATTERN ANALYSIS

The overall patterns in the reactions of the crop farming system in North-East Bulgaria to the above-explained challenges are identified according to the system archetypes developed by Kim (2000). In our point of view, the analysed challenges and behaviour of the system could be classified as follows:

The extreme weather conditions (droughts, hail and floods) (noise), Lack of labour force (trend) and Constantly changing policies and regulations (trend) are the most challenging challenges in our study. Any of these three challenges would compromise system performance despite of the efforts which farmers and other system actors put. Therefore, the archetype *LIMITS TO SUCCESS* allow to analyse the system behaviour pattern. The challenges are addressed and coping strategies applied by the different actors as seen. But the limits are still in place and the farming system is in the conservation phase concerning the processes of demographic and risk management to deal with climate changes as well as with the governance. The lack of proper risk management strategies (e.g. utilisation of insurances) prevents increase of the system resilience

through adaptability and transformability in the light of presented challenges both of which are expected to be present in the future. At the moment the governance in particular the policy organization and implementation are the major factors for system robustness which in long-term perspectives seems not beneficial for the crop farming system in the studied region. On the other hand, the lack of labour required strategies (mechanizations, innovations, further trainings and education considered as adaptations) which increased the productivity and replaced/lowered the need of workers which currently improve the resilience of the crop farming system. The three challenges represent different types as noise and trend but showed similarities in regard to their continuity for long time as well as their persistence/endurance despite of the all coping strategies undertaken by the actors in the studied system.

Land ownership and their regulations (trend) – *SHIFTING THE BURDEN* – the last three decades many solutions have been searched for but the radical changes which to force landowners to be interested in long-term decisions are still only discussed, e.g. property taxes, to take responsibility in land management and to be accounted for damaging soil quality (at this moment land relationships are organized in a way where it is difficult to identify and ask for responsibility about negative effects on the natural resources and biodiversity). The challenge prevents adaptability and transformability of the system since both capacities require mid- and long-term decisions which is difficult to base on the one-year relationship. In long-term perspective the resilience of crop production in the region is worsen.

Price volatility (noise) and International markets and competition (trend) provoke systematic reaction of the crop farming system which could be considered as *SUCCESS TO THE SUCCESSFUL* archetype of behaviour. The constant efforts of farmers to get knowledge and information about markets and the trends in price fluctuations result in improving their economic performance and position in the regional chain built in the grain supply, trade and delivery. Thus, farmers are encouraged to invest in their education (usually their children' education) and in improving use of different market instruments.

Preservation of natural resources (soil fertility) (noise) coping strategies present a behaviour which pattern could be classified as *TRAGEDY OF THE COMMONS* because at the moment still single actions are undertaken by the farmers. But the complexity and the persistence of this challenge will always lead to lack of benefits for the system as a whole without common support and activities. The tragedy is that usually such behavior may decrease the single profit in short-term perspective in return for sustainable collective prosperity in long-term.

Consumers' preferences (noise) relates to the consumers' goals for safety and healthy food without damaging the nature. The gap between this goal and current situation in farming requires

time to be closed since the actions demanded and undertaken from the farmers' side need to time. Therefore, the pattern suitable to describe the system behaviour is *DRIFTING GOALS*.

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D6.2 GERMANY

Work Performed by Leibniz Institute of Agricultural Development in Transition Economies (IAMO)

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1 INTRODUCTION

The aim of task 6.1 is to identify integrated sets of conditions that effectively provide an enabling environment for resilient farming systems in Europe. Task 6.1 will integrate findings from workpackages 2, 3, 4 and 5 on resilience enabling conditions and their impact on the attractiveness of the farming sector and its capacity to enhance adaptive behavior and learning. By linking these outcome values to the combinations of conditions, it is possible to identify which combinations of conditions are likely to improve resilience. The results of task 6.1 will feed into task 6.2 where the identified sets of conditions will be translated into guiding principles for a resilience enabling environment. The purpose of this protocol is to make sure that conditions will be characterised comprehensively and systematically across the various case studies.

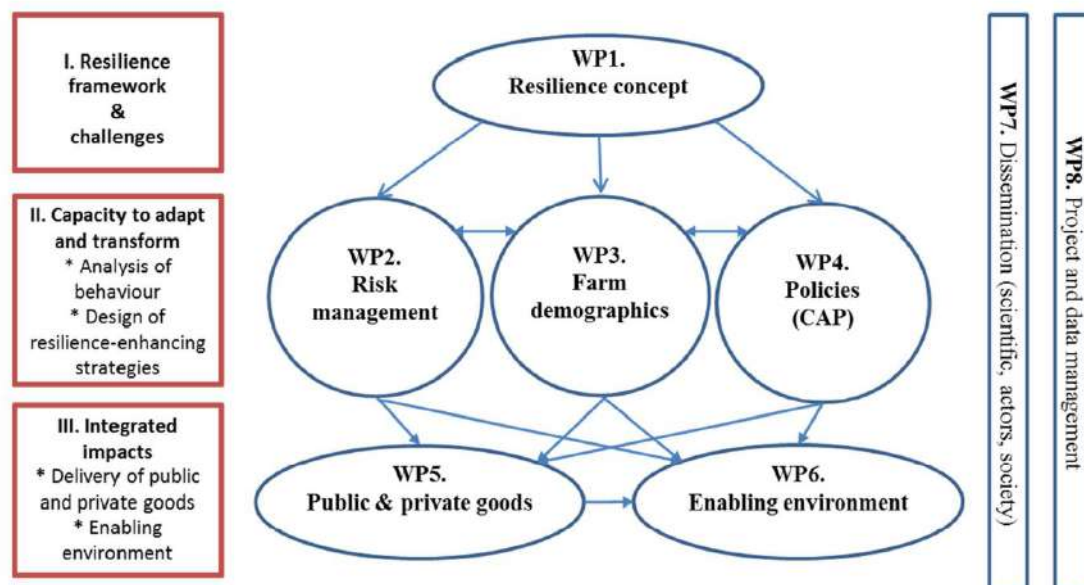


Figure 1 : WP structure of SURE-Farm

An earlier case-reporting protocol was developed and published as deliverable 6.1. To analyse how conditions in the enabling environment of farming systems interact with resilience and resilience capacities, we drew on the literature on agricultural innovation systems (AIS). A farming system, as defined in this project, is a system hierarchy level above the farm at which properties emerge resulting from formal and informal interactions and interrelations among farms, available

technologies, value chain stakeholders, urban and rural citizens, consumers, policy makers, and the environment (Meuwissen et al., 2018).

The concept of AIS acknowledges that innovation in agriculture—like resilience— is the outcome of an interactive and co-evolutionary process in which a wide range of actors are engaged. Therefore, we assume that this framework can be adapted to study farming systems and the conditions that enable or hinder the resilience of these systems. The protocol was inspired by Lamprinopoulou et al. (2014) and based on the analysis of how the structures (actors, institutions, resources) underpinning a farming system interact with the functions the enabling environment performs to stimulate resilience. This protocol has been further simplified and enriched with resilience concepts from the management literature (Duchek, 2019), resulting in an analytical framework which will be discussed in section 2. Section 3 introduces the methodology to analyse the enabling environment of each SURE-Farm cases study.

2 ANALYTICAL FRAMEWORK

Farming systems (FS) operate in biophysical, political, social, economic and cultural environments which are often far from stable. Frequently or unfavourably changing conditions can affect FS performance, i.e., the delivery of farming system functions. The dimension and direction of the changes of the environment are often uncertain and there are many unknown unknowns, i.e., events that cannot be imagined currently, let alone that their likelihood is known. Hence, safeguarding the functions of FS requires more than traditional risk management, which often assumes that the possible states of the future environment are known and that probabilities can be attached to each state, i.e., we know which shocks might occur and with which probability. This also means that it is not always clear how FS have to evolve to perform well in the future, since we do not know how that future will look like. Hence, the institutional and socio-economic environment in which farming systems are embedded should at the same time provide some direction to farming systems, but also help farmers keeping their options open and facilitate their flexible and smooth responses. An important policy implication is that to make farming systems resilient, it is not enough to build a safety net—the approach to which most resources are devoted in the Common Agricultural Policy (CAP). Rather, policy should assist farming systems actors to build resilience capacities beyond coping capacity (robustness) – which can amongst others be enhanced through a safety net – but also responsive capacities (adaptability and transformability) through creating an enabling environment that supports adaptations and transformations.

2.1 Defining resilience of farming systems

Resilience capacities refer to the capacity of farms, farmers and farming systems to anticipate (future literacy), cope (robustness) and respond (adaptability and transformability) to shocks and stresses. Actors and institutions in the farming system and in the enabling environment allocate resources in order to produce and support the production of public and private goods (thus fulfilling system functions like food production), but they can also divert resources to invest in resilience capacities. Improving resilience capacities means changing the resilience attributes, i.e., characteristics of the farming system that determine its resilience. Examples of such attributes are sufficient levels of profitability, the level of modularity, the system's openness, the diversity and its flexibility. Resources that are invested and mobilised can be of different forms. Financial resources may be invested in the farm business or set aside to form a buffer to deal with unexpected events. Farmers, farming systems and actors within the enabling environment may also invest in cognitive resources, that is, knowledge and know-how, and network resources, that is, connections and social capital. Physical infrastructure may be built in order to better deal with changes within the environment, examples being storage and sensor technologies. Often, resources are not deliberately reserved for improving resilience attributes, especially those that

support responsive capacities. There can be several reasons for that: farmers may lack resources because they can't build up financial reserves or they have to use most resources for supporting current operational performance or there may be anti-push factors (e.g., attachment to or even vested interest in the status quo) and/or anti-pull factors (e.g., high risk aversion) at play.

Resilient farming systems are those where actors in the farming system and/or in the enabling environment have invested resources into supporting the resilience capacities in such a way that they are able to cope with challenges, i.e., they are robust against external pressure. Robust farming systems are able to continue without having to change, i.e., without having to constantly tap into their responsive capacities in order to trigger a response. Nonetheless, besides coping capacities, responsive capacities have to be present. Indeed, at certain points in time, stresses build up, other types of challenges emerge and/or unanticipated shocks are so severe that farming systems are no longer robust, i.e., they are not able to continue to perform well enough in business-as-usual mode. At that moment, in order to continue to perform, farming systems have to use their responsive capacities in order to respond. Such changes might be modest whereby the main characteristics of the farming system remain intact (adaptations) or they can be more radical changes to the farming system (transformations). The ease with which they can do this reflects their responsive capacities (adaptability and transformability). The goal is to become again robust within the new environment so that they are again able to perform well within the changed environment, without having to constantly change. Further, these responses can also change the characteristics of the farming system in such a way that the resilience attributes and hence the resilience capacities themselves are affected. Anticipating capacities – referring to the capacity to detect trends that could lead to critical changes to the farming system and its environment and to be proactive – influence both the coping capacities and the responsive capacities on the one hand, and the need to use them on the other. As such, farming systems with high anticipating capacities are more resilient. Together, anticipation capacities, coping capacities (robustness) and responsive capacities (adaptability and transformability) determine a farming system's resilience (Duchek, 2019).

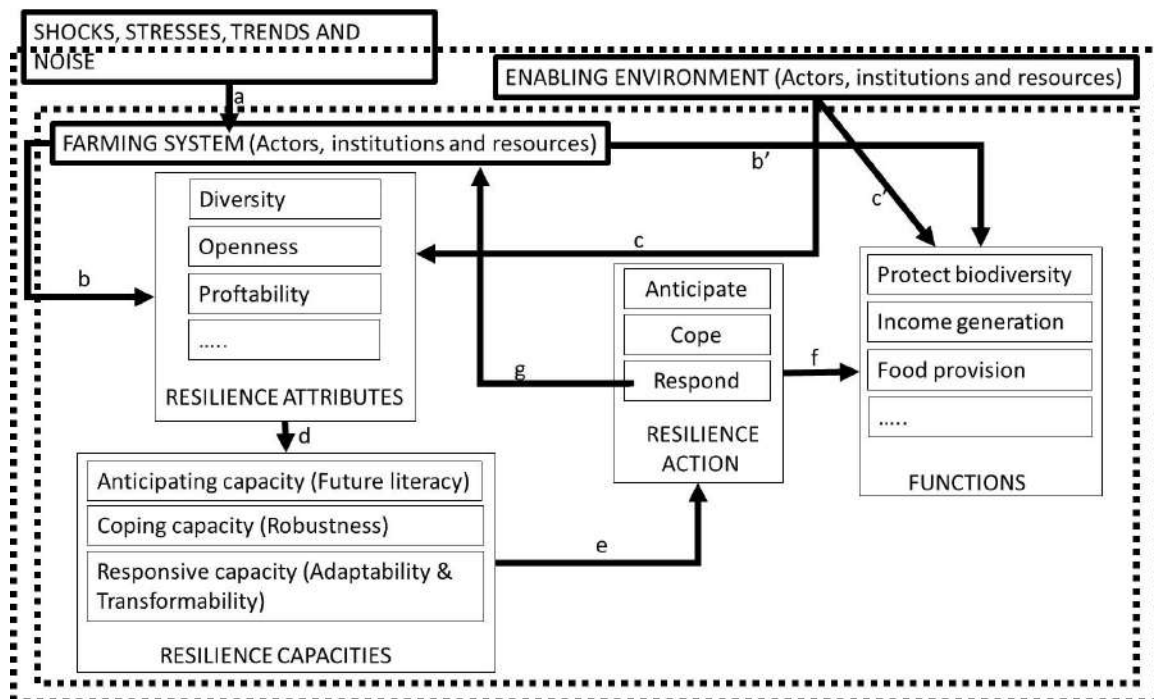


Figure 2. A conceptual view on building farming systems' resilience

a Challenges affect farming systems

b Farming systems actors may build and use institutions and invest resources strengthening resilience attributes

b' Farming system actors may invest resources into supporting current performance (functions)

c The enabling environment actors may build and use institutions and invest resources strengthening resilience attributes

c' The enabling environment actors may invest resources into supporting current performance (functions)

d Resilience attributes determine the level of the resilience capacities

e Resilience capacities determine how farming systems can deal with changes through resilience actions

f Resilience actions determine to what extent farming system continues to fulfil functions under the challenges

g Responses (adaptation and transformation) may lead to changes in the farming system, thereby affecting its resilience attributes and capacities.

2.2 Fostering farming system resilience

Fostering farming system resilience means building, mobilising different types of resources. Three questions related to activating these resources for resilience arise: (1) what characteristics of a farming system enable or constrain anticipating, coping and responsive capacities, (2) which actors can – or even should – play which role in building and mobilising resources to develop these capacities, and (3) how should institutions govern investment in and use of resources and capacities?

The first question relates to resilience enabling and constraining attributes, i.e., characteristics of farming systems that affect the anticipating, coping and responsive capacities. Within SURE-Farm, based on the analytical framework developed by Meuwissen et al. (2019), several of such

attributes have been identified. For example, more diverse farming systems tend to be more resilient than highly specialised ones, as more diversity increases the capacity to diversify risks. Farming systems that are more open to new ideas are also more resilient, as they find it easier to adapt to new circumstances. Particularly the second pillar of the CAP stimulates such attributes by providing subsidies for innovation and stimulating networks to exchange ideas, such as the EIP-AGRI. Farming systems that are more profitable can build financial reserves, thereby boosting their coping capacity. Nonetheless, improving resilience enabling attributes and removing resilience constraining attributes is quite complex, especially through single policy instruments only. Often this would require a redesign of the policy mix, as some policy instruments can offset the influence of other. For instance, diversification support policies could improve the diversity and spatial heterogeneity of farms within the farming systems, yet spatial planning policies often lead to a more spatial concentration of farming systems.

The second question relates to the role of actors within and outside the farming system. In farming systems, we can think of several extremes along two dimensions, namely collective versus individual; and private versus public. For instance, resources can be built and mobilised by the government. Agricultural research, especially in areas less attractive to private investors, is often funded by governments as individual farms are too small to set aside meaningful resources for research. Disaster funds are another example. On the other hand, resources can be invested—and capacities built up—by individual farmers, provided they make a profit. Hybrid models exist in which groups of individuals pool resources that may be matched by government funds, as for instance in the case of government-subsidised crop insurance. The question remains then how individuals and groups may have access to capacities and resources. It seems logical that a minimum amount of capacities and resources is needed at the individual level in order to get access to and absorb knowledge developed at the collective level. Whether capacities are built up by mobilising resources in a collective or rather individual way and by public actors, private actors or rather through hybrid ways depends on the type of challenges (e.g., the distinction between normal risk and catastrophic risk), but also on political mechanisms and priorities (e.g., whether society considers it a social or rather individual responsibility to support farmers to managing income volatility), and on historical path dependencies or institutional arrangements across the value chain (e.g., vertically integrated value chains versus spot markets).

The third question relates to the answers on the previous question, as these shape how resources and knowledge are distributed among actors. Information and power asymmetries lead to inequalities in terms of access to resources and capacities. Institutions like the CAP have evolved that determine whether and how capacities and resources can be accessed and activated by those who need it. This also includes gaining insights in institutions (formal and informal rules) that govern behavior of the actors and influence the interactions and relationships among actors.

Institutions encompass a set of common habits, routines and shared concepts used by humans in repetitive situations (soft institutions), organized by rules, norms and strategies (hard institutions). Formal and informal institutions influence how resources (knowledge, money, power) are allocated to activities that help farmers and farming systems to anticipate, cope with and respond to adverse events. For instance, national knowledge and innovation systems may be focused on a limited set of farming system models, paying insufficient attention—and thus resources—to novelty. Private standards that include provisions on the homogeneity of products could be a barrier for system diversity. The first pillar of the CAP plays a huge role here, as it determines who gets subsidies (direct income support and coupled payments) and who not, and also how market management measures may be used.

To conclude, policies and other institutions play an immense role in determining farming system resilience. Both the EU and its Member States allocate resources, but more resources tend to be mobilised to enhance the robustness of farming systems (the safety net approach) than to stimulate adaptation and especially transformation. Fostering farming systems resilience is done through (re)designing institutions and building and mobilising resources in order to enhance resilience enabling attributes of farming systems (and remove resilience constraining attributes). As resources are finite, this could mean prioritising the use of resources to build resilience over the alternative use of these resources to support current performance. The current EU Green Deal, and more specifically its Farm to Fork strategy, while being very systemic in nature, has its core functions in supporting functions (especially the production of public goods) but does not devote specific attention to supporting resilience attributes.

3 METHODOLOGY

The original method would involve that all previous deliverables and reports (and possibly data) had to be consulted again, based on a framework, in order to integrate all previous findings. However, this was considered both methodologically cumbersome and too time-consuming. Hence, a four-step approach has been defined. For each step, you do need to consult data and results from previous tasks, but in a more targeted manner. Do not just copy-paste findings from one single deliverable which seems most relevant, but really integrate findings from different deliverables. For methodologically scrutiny, it is advisable to apply some iteration to this where you start with a prior analysis, and then further improve this through integrating other SURE-Farm results, possibly doing some additional research activities such as targeted interviews or even focus groups. Further, it is also recommended to apply some iteration by doing this task not with just one single person but with a (small) team for further triangulation.

STEP 1: FARMING SYSTEM AND ENABLING ENVIRONMENT ACTORS AND INSTITUTIONS

The actors of the farming system in the Altmark and its enabling environment have been identified and discussed with stakeholders in various research activities during the SURE-Farm project, most notably the learning capacity interviews (for D. 2.3) and focus group discussions (for D.2.4 and D.5.2).

The following description of actors distinguishes between farming system actors and actors in the enabling environments. Farming system actors are in a relation of mutual influence with farmers whereas actors from the enabling environments influence farmers without being influenced by them.

For the farming system in the Altmark, dominated by arable and mixed farms, a total of five actor groups were identified which influence the farming system and are equally influenced by it. At the farm level, we identify the groups farmers and farm workers (employees and family workers). Beyond but mutually influencing the farm level, farming system actors comprise consultants, producers associations, and machinery-sharing cooperatives.

Actor groups which shape the farming system but are only scarcely influenced by it are represented in eleven groups: local government, policy makers, funding providers, input suppliers (feed, seed, technology, etc.), financial institutions (banks, insurance companies, local credit unions), processors, retailers, researchers, consumers, civil society (NGOs, activist groups), and media.

Table 2 allocates the identified actor groups and their corresponding formal and informal institutions to the actor domains.

Table 2: Actors with their institutions in the Altmark's (DE) arable/mixed farming system and in its enabling environment

Actors	Formal institutions	Informal institutions
Enterprise domain: Farms, cooperatives, farmer associations, input suppliers, processors (dairy factories, mills), retailers, accountants, banks, insurance companies	Cooperatives Companies Type of farm: corporate or family farm	Attitude towards cooperatives Attitude towards private companies Actors' interests
Government domain: European Union, Federal government, Local government, Federal and regional ministries of food and agriculture and their subsidiaries, politicians	CAP, statutes (minimum wage statute), Regulations (biogas directive, reduction milk price quotas, ban of poultry cage)	Accountability Decision making Farmer participation Societal participation Actors' interests
Intermediary domain: All actors of the farming system Authority for Agriculture and the Reorganisation of Land, State Institute for Agriculture, Forestry and Horticulture in Saxony-Anhalt, Funding providers (mainly public)	Public and private organizations Individual companies Contracts between farmers and traders and/or processors	Value chain relations and forms of coordination and communication Governance Weak farmers negotiating power Weak exchange platforms
AKIS domain: Consultants, Academic and research organisations, universities, farmers specialized agricultural services, agricultural journals, specialised radio/TV broadcasts, trade press	Universities, Schools, Training institutes, Private companies, Associations Media	Innovations and R&D, Technology adoption Attitudes towards technologies Infrastructural conditions Actors' interests
Societal domain: Farmers' movements, farm workers, other farmers, final consumers, civil society organisations	NGOs Public organizations Citizens Media companies	Societal visions on farming Environmental attitudes Consumers preferences Actors' interests

The current performance of the farming system in the Altmark is a result of roles and functions of all the listed actors which influence the system either in a direct or indirect way. The farmers are at the centre of the system and are bearing the biggest share of responsibility for the provision of its functions and managing the risks which affect their farming capacities.

Most of the utilized agricultural area is used by mixed farms, while the highest number of farms are the arable farms. In average the mixed farms are larger farms compared to the arable farm. In terms of utilized agricultural area, cooperate farms have the highest share but in terms of the number of farms, the family farms comprise half the share. This is reflected in the fact that most of the corporate farms have a large farm size. Only some 15% of the actual workforce in the agricultural sector in the federal state of Saxony Anhalt to which the Altmark belongs is non-salaried family labour while 79% is permanently hired labour, the remaining 6% is hired seasonal labour.

Cooperation between farmers exists on the basis of trade organised on a cooperative basis (input supply and retail), cooperative diaries and machine-sharing cooperatives. In addition, there are several German farmers' associations with active regional and local branches which lobby for farmers at the respective administrative levels and provide some agricultural training and information services.

During the focus group on risk management strategies (T.2.4), roles of stakeholders in the farming system regarding an improvement of risk management were discussed with participants. In this context, especially the importance of banks and insurance companies was highlighted. Their importance was seen to lie in the support during planning, the provision of information, the classification of investment, compensation of deficits and the enablement of flexibility through loans.

At the government domain, all actors and institutions at the respective administrative levels play a role in defining the policy framework which steers the farming system and enables or hampers stakeholders' capacities. By setting specific incentives via funding, compensation and other measures of support or restricting and sanctioning certain behaviours, the actors in government institutions directly influence farmers' strategies and those of all other stakeholders in the farming system. Another level of effect on system performance is a perceived high barrier for action through bureaucratic measures. In the above-mentioned workshops, there was a broader consent among stakeholders on the perceived negative impact of rigid bureaucracy in the Altmark which is regarded to reduce farmers' ability to implement risk management measures such as farm diversification or increase farm efficiency.

The intermediary domain is less shaped by actors groups but rather by formal and informal institutional *processes* in which multiple actors have a stake. One important process is the formation of relations and forms of coordination between value chain stakeholders. These processes can be quite fast and dynamic, when new value chains are evolving (e.g. with the emergence of an organic product chain), or tendentially static when roles of strong players are established. The latter is rather the case in the Altmark and there were a few complaints on the weak bargaining power of farmers in the conventional food chains. Another important process that became clear during the SURE-Farm research activities in the Altmark, was the weak process of learning and information sharing among farming system actors. Especially under the increasing frictions between conventional farmers and civil society groups (often urban-based), the need for improved exchange of positions became more apparent during the farmer protests 2019. Many farmers mentioned to engage in various forms of informal exchange with other farmers, especially when it comes to information sharing.

In the AKIS domain, all actors and institutions which are engaged in the development of knowledge and methods are relevant for the farming system. In the case of the Altmark, farmers get their knowledge updates mainly by private consultancy firms and large companies engaging in service and trade as well as specialised agricultural journals or broadcasts and other specialised media channels. The role of consultants was particularly emphasised for the improvement and implementation of risk management strategies at farm level. They in turn, feed their knowledge from latest research findings from the various research organisations. It was, however, underlined in the focus groups that information exchange between farmers and research is perceived as insufficient.

Similarly to the governance domain, the societal domain gives incentives and pressures to the farming system, especially to farmers. It is not only consumers' preferences which stimulate the market but also their expectations towards production processes which increasingly guide the performance of the system. As a result, many retailers and processors have introduced process standards into their value chains. Such standards and new consumer expectations and associated activities from civil society organisations have increased pressures on conventional farmers which they were highlighting strongly during the focus groups. As a result of these perceived pressures, farmers in Germany have formed a new farmers' movement which protests against political and societal pressures on the farming system.

STEP 2: IDENTIFY CHALLENGES AND ADVERSE EVENTS IN THE LAST 10 YEARS

In the Altmark, challenges are present in economic, ecological, social, and institutional spheres. Most of the identified challenges are long-term challenges and are a result of the broader transformation processes after Germany's unification and more precisely of the transformation of the agricultural system in the Altmark. In addition to such structural underpinnings of the system, a number of short-term effects also challenge farmers' performance.

The following list presents challenges which were mentioned in the farm survey and subsequently discussed in the FoPIA focus groups.

Table 3: Main challenges of the farming system in the Altmark

Sphere of Challenge	Specific Challenges	Type
Climate Change	• Increasing droughts and floods	Trend
	• Poor sandy soils	Noise
	• Unequally distributed water channels	Noise
Policies and regulations	• Continuously changing policies and regulations	Trend
Markets	• Fluctuating market prices of agricultural products	Trend
	• Financial crisis 2009	Shock
	• Reduction of milk price (abolishment of milk quota)	Shock
Institutional environment	• High level of bureaucratic barriers	Trend
	• Lack of exchange platforms	Trend
Societal expectations	• Decreasing acceptance of conventional agriculture	Trend
	• Social pressure on farmers	Trend
Rural development	• Transformation of the region	Trend
	• Lack of infrastructure	Trend
	• Low support of rural life	Trend
Labour supply	• Demographic change	Trend
	• Negative reputation of agriculture	Trend
	• Lack of regional infrastructure	Trend
Succession	• High investment required by the successor	Trend
	• Demographic change	Trend

The overarching challenge for the farming system in the Altmark is the **climate change** which comes with a higher frequency of extreme weather events such as droughts and floods. Already after two subsequent years of droughts, particularly arable farms are pushed to their limits of functionality. Droughts are hitting farms in the Altmark strongly due to its sandy soils which have low water storage capacity. At the same time, irrigation is difficult for many farms because of the historically unequal distribution of water channels. In addition, other extreme weather events such as floods and storms over the past two decades have led to major harvest losses.

In the course of the SURE-Farm research activities, farmers often expressed their frustration with continuously changing regulations and high regulative demands. Both are regarded to have negative effects on their ability to invest into adaptive measures. While continuous changes in regulations provide uncertainty and thus insecurity for farm long-term management and innovation, too high regulative demands (for instance regarding slaughter or the control frequency of biogas facilities) are often seen to hamper processes of diversification and impede investments.

Arable and mixed farms in the Altmark, being producers of bulk agricultural commodities such as cereals and milk, are strongly dependent from developments in the world **market** prices of these products. While price volatility is typical to these markets and most farms normally can handle them, extreme events such as the financial crises in 2009 hit them strongly and push many farmers to the brink of bankruptcy. In addition, due to often low world market prices for cereals, margins of farms remain low what is a source for the low attractiveness of the sector and many other challenges. Similarly, mixed farmers with dairy production in the Altmark were affected by the abolishment of the milk quota and the subsequent sharp decline in milk prices what made the business less viable. As a result, the number of smaller dairy farms is continuously decreasing, especially during periods with low milk prices.

Several shortcomings in the **institutional environment** of the farming system became apparent during the research activities. Especially during T.2.4 on possible improvements for risk management strategies, high bureaucratic barriers were highlighted by participants. A rigid bureaucracy with some inflated, time-consuming procedures and long waiting times were blamed for reducing farmers' flexibility to respond to challenges and manage risks, and therefore became a challenge on their own. Another institutional shortcoming revealed during the FoPIA2 focus group and concerns the lack of institutionalised platforms for exchange of knowledge, experiences, and perspectives between diverse farming system stakeholders.

Climate change and its increasingly noticeable effects have fuelled the societal debate on the ecological sustainability of the conventional model of agriculture and its underlying policies. This

debate became increasingly polarised and characterised by a tendential ignorance of practical and economic constraints for many farmers. A stronger participation of farmers, civil society groups, and other relevant stakeholders in the policy process could contribute to a broader **societal acceptance** of the agricultural system. The increasing lack of societal acceptance particularly of conventional farming has caused focus group participants to share their feelings of social pressure and to complain about the lack of societal appreciation of their work. Moreover, a broader societal advocacy for animal welfare puts pressure on established intensive livestock systems.

In addition to these challenges, which directly shape the performance of the farming system, the low attractiveness of living in the area is a major impediment for its flourishing. **Rural development** in the Altmark drastically lags behind many other rural areas in Germany. The current situation of the Altmark's low level of development is a result of an uncompleted transformation process after the unification of Germany. While farm employment has been drastically reduced (in some cases up to 90%, Marten 2010) during the transformation of the agricultural system, other employment opportunities were almost not created which led to a broader exodus from the region. The lack of highly paid jobs in the region till today contributes to the high level of outmigration of the qualified younger generation. Further, the level of infrastructure in the Altmark is very low; especially mobility and communication technologies lag behind while social and cultural offers are almost absent and medical care quite distant for many rural dwellers. All this together makes a living in the area highly unattractive and strongly affects the availability of **farm workers** and **successors**. This is aggravated by the low level of attractiveness of the farming sector in general (bad societal reputation and low remuneration for agricultural jobs) and high demands on successors such as a high need of on-farm investments.

STEP 3: RESPONSE ANALYSIS

The response analysis is conducted for all spheres of challenges while taking into account most of their specific challenges. The analysis is based on D.1.3, D.3.1, D.3.5, D.5.2, D.5.3, D.5.5 and the interpretations by the authors. The analysis is structured into four steps which are followed for each challenge respectively:

1. Analysis of the (possible) impacts on delivery of system functions
2. Description of if and how challenge has been anticipated

3. Description of if and how the farming system has been able to cope with challenge (deal without system change) and/or
4. Description of if and how the farming system has been able to respond to challenge (deal with impacts through changes to the farming system)

If for a challenge there is no bullet point 4, this means that no response strategies (leading to system changes) are identified for that challenge.

Climate change

1. While there are different scenarios on how climate change will affect middle Germany in future, the past two decades were characterized by an increase of extreme weather events which put pressure on farms' productivity. Agriculture is generally vulnerable to weather, and extreme events such as droughts, floods, storms etc. can lead to vast losses of harvest with strong impacts on farms. In a middle-run, varieties can become inappropriate for the local climatic conditions or cultivation can even become impossible. Therefore, the system function food production is most directly affected by climate change which further affects the economic viability of farms. If temperatures increase and heat peaks become common, animal production will also be affected as high temperatures can lead to health issues and slumps in production. Likewise are the functions natural resources and biodiversity stressed by more frequent weather extremes due to climate change.
2. Human-induced climate change has been largely and controversially discussed for decades. Although scientific evidence already urges decision-makers and society to take action since four decades, it is apparently challenging to take pro-active preventive and adaptive measures for all stakeholders.
3. Coping strategies that have been already applied to different extents comprise the selection of site-specific varieties which account for increased water shortages and new parasites, more efficient irrigation schemes, water extraction rights or plant-oriented irrigation, adapted tillage and crop-specific fertiliser. Livestock production shifts to more robust breeds and extensive grazing. In addition to such on-farm strategies, weather assurances and derivatives gain importance but since climate change has a long-term effect on farming and is not just a weather extreme, new insurance models are currently being developed.

Continuously changing policies and regulations

1. Continuously changing policies and regulations have potentially an impact on all functions of the farming system since they define the frame in which stakeholders are able to perform and thereby set conditions how stakeholders positively or negatively shape the system functions. Agricultural policies and regulations most directly affect the system functions food production and economic viability of farms. If they are unstable and frequently changing, important farm strategies such as long-term planning, risk-management, and innovation tend to be affected having negative impact on farms' resilience capacities. Many farm investments or the shift towards new production lines are long-term processes often based on a longer planning and permit allocation periods. If regulations and policies change meanwhile, this can have severe impacts on these innovation and adaptation processes and create hidden costs.
Still, new regulations often reflect societal demands. The ban of poultry cages, for instance, goes back to a reduced societal acceptance of this farming approach and positively impacts the function animal welfare.
2. Many stakeholders are aware of the problem that too frequent changes are a burden for implementers (mainly farmers) but it is to some extent intrinsic to the nature of politics to renew agendas depending on the prevailing political climate. Especially those who are affected by it, mainly farmers, are broadly aware of the challenge.
3. The major coping strategy of farmers is to allocate more financial resources and time to alignment with changing regulations. On the one hand, they have to engage in getting information on new directives and requirements (time). Often, farmers seek advice from farmers' associations or consultants (costs). The implementation of respective measures to fulfil with new requirements often demands on-farm investments; hence, the challenge is handled by farmers by allocating scarce resources to it. Farmers associations seek to advocate for farmers' interests in the political deliberation on new or changing regulations while, for instance, lobbying for transition periods or for the safeguard of already existing facilities.

Markets and prices

1. Volatile and low market prices affect the performance of farms and therewith many other functions and attributes of the farming system. If farms' economic viability is constantly at risk or becomes too low, farmers are under current stress and need to pursue either strategies of value adding or cost reduction. A low profitability of farms also implies that farms are not able to effort attractive salaries and therefore might face difficulties to attract higher qualified staff. Less efficient farms might even drop out of the sector. This

survival of only the most efficient farms has an impact on the cultural and social dimensions of the farming system. Besides, the low level of gross margins contributes to the low degree of the attractiveness of engaging in agriculture.

2. Volatility of agricultural commodity prices has increased over the past decades. This is especially the case after the stepwise reduction of market protective measures by the EU and the increasing convergence with world market prices. This is a phenomenon of which all key stakeholders are aware. For instance, the abolishment of the milk quota system is well known but still a certain share of farms is struggling with the adaption process.. Farmers and others stakeholders follow price trends and market developments and use this as basis for their decision making. Farmers in the Altmark get information of cereal and milk price developments for instance from specialised journals, service providers or traders, consultants and farmers associations.
3. Besides being informed on market developments, coping strategies to handle low and volatile market prices comprise strategies to increase farms' viability as for instance through diversification, measures of value adding or cost saving strategies. Moreover, the creation of financial buffers through savings is a reaction to this challenge. A strategy of diversification and increasing value adding often applied in the Altmark is the establishment of biogas plants (mainly by large dairy farms). However, the financial improvement for farms is not necessarily given since they often have to pay higher rents for the land when used for biogas production (Appel et al. 2016). Due to the increased demand for bioenergy crops, some farmers opted for change of their production towards higher shares of maize and rapeseed which are more profitable than other cereals since they benefit from stable prices through guaranteed feed-in compensation for bioenergy crops.

Other value adding strategies applied in the Altmark comprise intensification, the increase land and herd sizes, and the use of highly productive varieties. The mechanisation of farming practices has been used to increase efficiency and productivity of farms and therewith increase financial viability which leads to improved robustness towards price falls. Typical costs saving strategies are savings in the production processes through a more efficient application of production means, the stop of investments or tillage without ploughing while increasing the use of Glyphosate.

4. Responses to volatile and often low market prices which changed the system are the increase of number of livestock to improve effects of scales, the shift towards suckler cow husbandry or the abandonment of dairy production by mixed farms. While this process can be regarded as a response to market demands, the challenge is not overcome and in combination with other challenges many farms in the region are close to their economic thresholds.

Institutional environment

1. If bureaucratic barriers are considered by farmers to be too high, they hamper their willingness and ability to quickly respond to challenges and efficiently manage risks. This has potentially negative impacts on the functionality of their farms, thus affecting functions such as food production and economic viability.
2. To which extent there is awareness of this challenging trend could not be revealed with the SURE-Farm methods. In general, the streamlining of the state and the reduction of the public sector's responsibilities is a main feature of the neo-liberal political system and the decrease of bureaucracy is seen as a crucial part of it. Yet, especially the older farmers participating in the workshops reported to experience the contrary and see a continuous increase of bureaucratic requirements for farming.
3. There are no broader coping strategies in the farming system besides the political target to reduce bureaucratic burdens for farmers which did not materialise yet. Farmers just have to handle the status quo, some seek support from consultants or other advisors, some invest more time in getting through paper work, and some others refrain from the activities in question which need the bureaucratic effort.

Societal expectations

1. Fuelled by the latest climate change debates, agriculture became a central target of political claims in addition to the long-standing demands for the improvement of animal welfare in intensive livestock farming. High societal expectations, concerns about animal welfare and the decreasing acceptance of factory farming exert (mainly psychological) pressure on farmers and therefore reduce the attractiveness of engaging in agriculture, be it as employee or farm manager. This, in turn, in combination with demographic dynamics, puts a general pressure on the resilience of the farming system and its ability to continue to provide its functions.
2. Social expectations are dynamic and issue of constant change to which all sectors somehow have to adapt. The awareness of these claims is widespread among farming system stakeholders whereas positions towards it depend on the respective functions of the stakeholders. Yet, the awareness of such underlying societal phenomenon can difficultly translate into the alleviation of the dynamic and needs a process of mutual rapprochement.
3. In 2019, farmers in Germany have formed the movement "Land schafft Verbindung" (land connects, translation by authors) and many became politically active by joining protests.

One of their main matters is the wish for a broader public appreciation of the importance of their work.

If channelled and moderated well, a societal debate on the ecological and social sustainability of farming practices which is free of stigmatisation and blaming has also the potential to foster adaptive processes where farmers and policy makers reconsider prevailing methods and align them with new societal demands and ecological imperatives. In addition, farmers take part in voluntary private labelling schemes, e.g. the “animal protection label” (Für mehr Tierschutz) or the label “controlled animal welfare” (Tierschutz kontrolliert) which foster the improvement of animal welfare. In order to adapt to these societal claims, some funding schemes are available for farmers, e.g. the Agricultural Investment Funding Programme (AFP). The AFP is the central program for promoting investments in agricultural holdings in Germany. The focus was on supporting investment measures for a competitive, sustainable, particularly environmentally friendly and animal-friendly agriculture with the general approach "public funds for public services" (Ämter für Landwirtschaft, Flurneuordnung und Forsten 2020, authors' translation).

Rural development

1. The low level of rural development is an underlying challenge that directly and indirectly affects several functions of the farming system. Directly affected are the functions attractiveness of the area and quality of life. The absence of important societal and cultural offers and key infrastructures is a disincentive for in-migration, and negatively impacts the availability of farm labour and successors in the area. This, in turn, shapes the economic viability of farms and their ability to provide quality products. Moreover, the low level of regional infrastructure, especially weak internet connections hamper farmers ability to network or use direct sales platforms, for instance.

Especially in marginalised rural areas in East Germany, there is a trend of increasing right-wing populist movements among dwellers and a potential threat of further radicalisation if the marginalisation of rural regions is not reduced.

2. There is broad awareness on challenges of outmigration and demographic change in the Altmark among stakeholders in the farming system accompanied by a broader consensus that efficient measures are needed to counteract these potentially mutually reinforcing dynamics. Already since the aftermaths of the reunification, there are plans for the expansion of the highway network but the process is taking long. Till now, the federal states' efforts to scale up rural development interventions are not showing expected

results. The challenge of low levels of rural development is well known at the various political levels

3. The European Agricultural Fund for Rural Development provides some funding for rural development in member countries of the EU. In the federal state of Saxony-Anhalt, to which the Altmark belongs, the focus areas are the promotion of knowledge transfer and innovation in agriculture, forestry and rural areas, improving the viability of agricultural farms, the restoration and improvement of ecosystems in connection with agriculture and forestry, and the promotion of social inclusion, poverty reduction, and economic development in rural areas (Sachsen-Anhalt 2020). Moreover, public infrastructure extension programmes are ongoing, such as the building of a new highway which improves the connection to urban centres like Berlin and Hamburg. Farmers and other residents of the region build partnerships and engage in the expansion of high speed internet. In some cases, farmers become active in the field of municipal services, for instance by clearing and maintaining winter roads.

Labour supply

1. In the Altmark, seasonal workers are almost irrelevant. Across all types of farms in the Altmark, labourers are mainly permanently hired qualified employees. The lack of such employees leads to unfilled jobs on farms and changes in their organisational forms. The shortage forces farms to make high investments in labour saving mechanisation or exit labour intensive farm branches such as dairy production. These high investments are associated with a financial risk for the farms. In addition, the lack of infrastructure is problematic, as it slows down the digitalization of agriculture.
2. Farmers, politicians and other relevant decision-makers are aware of that problem and the complexity of its sources (demographic change, low attractiveness of the region, low remuneration of demanding agricultural jobs, negative reputation of agricultural sector, etc.).
3. Coping strategies applied by affected farmers and farm managers embrace an earlier start of recruitment processes, the investment into trainees, and labour substituting technologies. A strategy being discussed in the workshops but not broadly implemented yet is the establishment of forms of cooperation with schools in order to bring agriculture closer to the future generation.
4. In the case of labour shortage, some responses have been implemented by farmers which change the system in a lasting way. For instance, farmers changed the focus on their farms and abandoned livestock farming shifting to crop production which is less labour intense. Farms with a solid equity base substitute labour with technology, for instance, dairy farms

compensate the lack of skilled workers by more automation of practices (milking, feeding and mucking).

Succession

1. Farm succession, equally negatively affected by the reasons stated under “Labour supply”, is a challenge which potentially hits the farming system of the region in the next years. After reunification, many of the farmers or farm managers who took over were in their forties and are currently approaching the age of retirement or are even beyond. The potential extent of the challenge will have to be seen in the coming years. It is unlikely that all farms will find a successor, however adaptations in the farming system are to be expected, so that the production factors (especially land) of the exiting farms remain further in the production. Therefore, an impact on the farm system function is unlikely although the effects on the farm level could be considerable. This is supported by simulation results of the AgriPoliS model in which no major impacts of succession levels on the functioning of the system is revealed.
2. There is a general knowledge of the challenge among farming system stakeholders. However, due to its complexity and the underlying societal structures, it is a long-term process to deal with it.
3. Coping strategies encompass all strategies that seek to improve the sector’s reputation, improve viability of farming, and to reduce the successors’ burdens when taking over the farm (i.e. to reduce succession costs). An important example is the Young Farmers Premium by the EU (. Nevertheless, in the case of the Altmark, this tool did not prove to be efficient yet.

STEP 4: PATTERN ANALYSIS

System archetypes

The following is an attempt to allocate the above described challenges and dynamics in the farming system of the Altmark to the provided archetypes.

The challenge sphere **climate change** can be associated with the archetype “**shifting burdens**”. Indeed, most of the strategies are coping measures, mainly focusing on handling symptoms of climate change rather than trying to reduce its sources. This becomes evident with the widespread approach “climate change adaptation”, which seeks to prepare farmers and regions to the expected changes. The above mentioned coping strategies, site-specific, more efficient irrigation schemes or adapted tillage are all adaptive steps to reduce negative effects of climate change. While adaptive measures are definitely important, measures of climate change mitigation such as the reduction of greenhouse gas emissions and the enhancement of environmental services of agriculture equally need to be promoted.

The challenges linked to **markets** and volatile prices for agricultural commodities show elements of the archetype “**success to the successful**”. In a setting of competition, only the most efficient farms are able to survive and less efficient farms drop out. Even if there are no direct policies and regulations that favour the successful, successful farms in the Altmark benefit from the exit of unsuccessful farms or those without successors by taking over their farm lands.

The problem of low prices is long-standing and measures seeking to respond to it only manage to cope with symptoms while the challenge-causing constellation is not affected (“**fixes that fail**”). One example where the response strategy bears the risk to fail due to negative side-effects is the establishment of a biogas plant which is a diversification strategy seeking to improve farm profitability. In some cases, due to increased rent payments and high running costs of the facility, margins tend to be low and might even lead to a worse financial situation of the farm than before the diversification strategy.

Despite attempts to reduce bureaucratic barriers and to ease and shorten processes of allocating permits, the level of bureaucratic barriers still remains high and is perceived as a burden for farmers participating in the above mentioned focus groups. This indicates that the approaches applied to improve the situation are not fitting the challenge well, hence can be regarded as “**fixes that fail**”. Similarly, continuously changing policies and regulations for the same fields of action and the associated challenges at the implementation level to comply with them indicate that here too, the challenge can be allocated to the archetype “**fixes that fail**”.

While still not being at this level, the challenge sphere **societal expectations** shows elements of the archetype “**escalation**”. In the past few years, the decreasing societal acceptance of conventional agriculture and intensive livestock farming gained more attention by the media and a broader societal debate on the desired future of the German food and agriculture system emerged. This debate is to some extent characterized by a less differentiated contraposition of conventional and organic farming. This trend became apparent, e.g. when two large, tendentially

opposing farmers and civil society movements demonstrated for their visions the same day. But the dynamics also have positive aspects and the will for rapprochement and cooperation is generally present. It is therefore important to institutionalise platforms of exchange to avoid further polarisation in the debate and prevent dynamics of escalation.

The challenge sphere **rural development** embodies challenges which can best be allocated to a reversed archetype of “**success to the successful**”. Success to the successful describes the process of favouring the already successful groups and actors. Looking at the weak endowment of many important resources in the Altmark, we observe the down-site of this archetype here that is the continuous marginalisation of the already marginalised. Still going back to structural adjustments after Germany’s reunification, the region systematically suffers from a lack of opportunities and low levels of infrastructures. Especially the weak internet network hampers farms’ in many ways, starting with online bureaucratic procedures, using the internet as marketing platform or even with implementing measures of precision farming.

The challenges **labour supply** and **succession** show aspects of the archetype “**limits to success**”. While many farms might have the necessary equipment in place, if it is not able to recruit qualified staff who can handle the milking machines or manoeuvre tractors and other heavy machinery, the farm faces difficulties to perform successfully. Therefore, the shortage of qualified labour is a pressure on farmers which negatively affects their performance and requires them to take adaptive measures. Even if labour shortage can be supplemented by technology, this option is only available for farms with sufficient capital to invest in innovation. At the same time, this technology still needs to be managed by employees (a smaller number) which need an even higher degree of qualification. Yet, the difficulties of farms to provide attractive wages also limit their success. Similarly, the challenge of generational renewal affects the success of a farm. In most cases, succession costs are very high and put a financial burden on the successor which potentially limits the success. If no successor is available, the farm has to quit business, which is the most extreme case of limited success.

Patterns across challenges

In the Altmark, the pattern across challenges that is the most apparent is that almost all challenges are trends and based on long-term dynamics. Moreover, many of them can only be understood in the light of the broader transformation process the region was undergoing over the past thirty years. As became visible in step 3 response analysis, almost all trend challenges lack solid

responses and coping strategies only manage to adapt to the situation without overcoming the challenge. Hence, the farming system shows a good degree of robustness and adaptability while transformability is low.

The two responses identified, namely the increased mechanisation due to low margins linked to low prices, and the changing from livestock to crop production, are responses which lead to changes at the farm level but do not affect the farming system in more general. The most important structural change will likely stem from the low viability of farms and their exit as well as the lack of successors. However, the two response strategies being pursued by farmers, indicate that policies and regulations often are not efficient and that conflicting challenges can provoke trade-offs between interventions.

Further, most of the coping strategies tend to only handle the status quo and show farming system's capacities of robustness and adaptability. Since many farming system stakeholders still perceive a high level of pressure stemming from these challenges and allocate them close to thresholds, the promotion of transformability should be expanded. For example, there should be alternative income opportunities for those managers and employees who exit the sector.

Noise challenges are aggravating trend challenges, as becomes most visible with respect to the role of ecological conditions in the Altmark and how they are affected by the trend challenge climate change. Similarly, shock challenges are more severe in a setting of overall trend challenges which make the system more vulnerable to sudden shocks. This relation can be illustrated with the reduction of the milk prices which, together with the trend challenge of labour shortage, forced farms which were already under strong financial pressure in the setting of the system's trend challenges to abandon milk production.

Patterns across system functions

The functions most strongly affected by challenges are the public function food production and the private function economic viability which are among the most directly linked functions to the farm level. The negative effect on the private function economic viability and the therefrom emerged need to reduce costs trigger several secondary negative effects, mainly in the public sphere. These effects concern, among others, the functions animal welfare (more animals per unit), natural resources, biodiversity and habitat (increased use of e.g. Glyphosate) or the attractiveness of the area (low wages and reduction of jobs). This pattern is an important insight insofar as farmers are increasingly urged to take into account the effects of their farming for the public functions. But these effects are mainly a result of their vulnerable economic position (due

to the described challenges) and the derived need to reduce their farming costs. The downwards spiral behind these dynamics becomes more apparent taking such patterns across system functions into account.

Roles of actors

We apply the table 4, provided by the UK partners, which we find very helpful to summarise our findings regarding the roles of the actors in the coping with and responding to the main challenges identified and their relation to resilience attributes and resilience capacity.

Roles of actors

Table 4. Roles of actors domains, what resilience attributes they strengthen and what resilience capacity they induce.

Domain	Enterprise	Government	Intermediary	AKIS	Societal
Challenges					
Climate Change	Suppliers: provision of new varieties and breeds; Farmers: adaptation of new planting material and irrigation techniques (plant-oriented, soil-specific); Farmers associations: support via information sharing; Banks: providing access to financial capital	Driving the agenda, setting incentives and regulations Support of public research and support	Process of linking all stakeholders to harmonize strategies and improve synergies	Advisors and agronomist: suggest adaptation strategies, Consultants: support with implementation Research institutions: contribution of research findings	(potentially) reward environmental friendly farming methods, Pressure on politics to mitigate climate change
Policies and regulations	Farmers: allocation of resources (time and money) to handle Farmers association: lobbying for farmers' interests during policy deliberation	Defining new regulations and policies		Consultants support farmers during implementation of new regulations	Societal expectations animal welfare and production standards

Domain	Enterprise	Government	Intermediary	AKIS	Societal
Challenges					
Markets and prices	Farmers: various coping strategies: being informed on price developments, creation of financial buffers, improve profitability, often via diversification or intensification, reduce costs; Traders and service providers: provision of price information; Banks and insurances: provide saving schemes	Investment support programmes, Renewal Energy Act (market stimulation with high guaranteed feed-in tariffs)	Markets as intermediary sphere connecting actors from different domains, segments, and regions	Economists analysing market and price developments, Research on best agronomic practices	Influencing markets via demand
Institutional environment	Farmers: just handling high barriers of bureaucracy, seeking advice, advocacy for reduction of bureaucratic burdens	Policies aiming at reducing bureaucratic barriers vs. directives keeping bureaucracy up		Consultants: advisory	
Societal expectations	Farmers: increase of self-organisation, engagement in voluntary labelling schemes;	Government as mediator between different interests	<i>Potentially:</i> Stimulating a process of exchange and institutionalising it through the creation of roundtables and other platforms, increasing	Media: reporting, mediating but also heating up the societal debate	Articulation of demands and expectations, engagement into dialogues

Domain	Enterprise	Government	Intermediary	AKIS	Societal
Challenges					
	Farmers associations: advocacy for member interests		vertical value chain cooperation and improving bargaining power for farmers		
Rural development	Farmers: contribution via their local role as employers, value producers, partially local service provider	EU: European Agricultural Fund for Rural Development; Local governments improving livelihood conditions in rural areas; Public funding for infrastructure projects			Social self-organisation (creation of social and cultural offers), NGOs active in the area
Labour supply/succession	Farmers: invest in trainees, labour substitution via technologies, shift to less labour intense production	Support the improvement of agricultural attractiveness, provide support for successors,	<i>Potentially:</i> A process of improving the reputation of agriculture and the living conditions in the Altmark to which all stakeholders can contribute		
Resilience attributes	MODULARITY Reasonably profitable: Low Production couples with local and natural	OPENESS, TIGHTNESS OF FEEDBACKS Supports to rural life: low to moderate	TIGHTNESS OF FEEDBACKS	SYSTEM RESERVES, DIVERSITY	TIGHTNESS OF FEEDBACKS, DIVERSITY

Domain	Enterprise	Government	Intermediary	AKIS	Societal
Challenges	<p>capital: moderate to high Response diversity: moderate Socially self-organised: high Appropriately connected with actors outside the farming system: moderate</p>				
Resilience capacities	ROBUSTNESS, ADAPTABILITY, TRANSFORMABILITY	ROBUSTNESS, ADAPTABILITY,	TRANSFORMABILITY	ADAPTABILITY, TRANSFORMABILITY	ADAPTABILITY, TRANSFORMABILITY



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D6.2 SPAIN

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1 Farming system and enabling environment actors and institutions

The Spanish CS is the extensive sheep sector in Huesca, Northeast Spain. In 2019, the province had 521,500 sheep heads and 934 farms (Gobierno de Aragón, 2020; MAPA, 2020), dedicated to lamb meat production. Farms are mainly medium-size (200-1.000 sheep) family business diversified into almonds, olive trees, cereal crops and vineyard (MAPA, 2020; Pardos et al., 2008). The territory comprises a mountainous geomorphology in the North and flat area in the South. This geographical characterization implies different sheep farming; more extensive and greater sheep specialization to the north, and less extensive and greater crop diversification to the South. Grazing in the region is based on pasturelands stubble fields, especially in the southernmost locations.

Actors are classified into two groups according to who make use of the system resources to deliver Farming System (FS) functions: 1) FS actors who are directly involved in the use of resources for delivering functions; and 2) the enabling environment actors, who indirectly influence the provision of functions.

Results from FoPIA workshops indicate that the most important functions provided by the FS are the provision of private goods, namely, ensuring the economic viability of the farm, the provision of affordable and healthy food products, and employment generation. The FS also provides public goods, such as the conservation of natural resources.

Considering these functions, the **actors in the FS** are the farmers, who make use of the system resources to provide the system's functions. The actors who belong to the **enabling environment** are the producers' organisations, cooperatives, technical and financial service providers, the slaughterhouses, retailers, input suppliers (feed), research centres/universities, civil society (consumers, NGOs and media) and local/national policy makers.

Actors are also classified according to five different domains: enterprise, government, intermediary, Agricultural and Knowledge Innovation Systems (AKIS) and society. Institutions are classified into formal and informal groups (Table 1).

Most of the actors in the farming and enabling systems are classified in the enterprise domain: Farmers, cooperatives, input suppliers (mainly fodder), technical (veterinarians) and financial service providers (bank and insurance companies), the slaughterhouses, and retailers (Table 1).

Political institutions, from the European Union to the municipality level, constitute the government domain. The European Union legislation is related to the main financial support of the sector throughout the CAP. National and regional regulations relate to wild fauna protection,

sanitary measures (especially in slaughterhouses), natural parks protection and urban measures legislation.

The intermediary domain is related to the producers' organizations, which promote and provide advice, training, legal assistance and lobby to farmers. The actors in the AKIS domain are the research centres and universities. They provide knowledge about improved breeds, feeding techniques and formulae, prolificacy measures, animal handling, shepherding techniques and new sanitary products.

In the societal domain, consumers are the main actors, whose consumption habits and behaviour influence in a large extent the sector. They indirectly influence the production of lamb meat, one of the main functions of the sector. They are also strongly influenced by social and mass media, especially in the last years, being exposed to campaigns against meat consumption and animal production. In this domain, environmental NGOs are also important highlighting the importance of the sector in the natural resources conservation, mainly through the pastures management.

Table 1: Actors in the Spanish extensive ovine farming system and its enabling environment.

Actors	Formal institutions	Informal institutions
Enterprise domain: <ul style="list-style-type: none"> • Farmers • Oviaragon, Ainsa • Slaughterhouses, retailers • Technical service providers • Input suppliers (feed) • Financial services providers 	<ul style="list-style-type: none"> • Cooperatives 	<ul style="list-style-type: none"> • Attitude towards cooperatives • Attitude towards retail • Environmental vision of the sector
Government domain: <ul style="list-style-type: none"> • European Union • Central and Regional agricultural and environmental administration • Municipalities 	<ul style="list-style-type: none"> • CAP: direct aids, greening aids Rural development programs • Wild fauna protection measures • Sanitary legislation (slaughterhouses) • Urban legislation • Natural parks protection legislation 	<ul style="list-style-type: none"> • Accountability • Farmer participation • Societal participation
Intermediary domain: <ul style="list-style-type: none"> • Producers' organizations (PO): Agroseguero, Interovic, ASAJA, COAG, UPA 	<ul style="list-style-type: none"> • PO • Interbranch 	<ul style="list-style-type: none"> • Ideal form of chain collaboration • Ideal farmer type
AKIS domain: <ul style="list-style-type: none"> • CITA; University of Zaragoza 	<ul style="list-style-type: none"> • Research centres and Universities • Cooperatives/POs 	<ul style="list-style-type: none"> • Technical vision on farming • Farmers' attitude to learn and openness to innovation

Societal domain:		
<ul style="list-style-type: none"> • Consumers • Environmental NGOs • Media 		<ul style="list-style-type: none"> • Societal vision on farming • Environmental vision of the sector

2 Challenges and adverse events in the last 10 years

Table 2 lists the main challenges in the sector during the last 10 years. Most of the challenges identified are considered as trends/stresses, mainly related to the social and economic domains. The trends/stresses are gradual changes that positively/negatively affect the FS functions. Two environmental shocks have been identified: increased wild fauna attacks and diseases outbreaks. Although they are expected it is difficult to predict the exact moment they will occur.

Table 2: Classification of main challenges in the Spanish extensive ovine farming system.

Challenge	Shock	Trend (stress)	Affect	Not affect	Not clear
Decrease in national lamb meat consumption		X	X		
Stagnation of lamb meat prices		X	X		
Increase of production costs		X	X		
Lack of services in the region		X	X		
Lack of skilled labour/generational renewal		X	X		
Lack of attractiveness of sector		X	X		
Increased competence to access to land		X	X		
Agriculture policies changes / regulations		X	X		
Increasing droughts		X	X		
Increased wild fauna attacks	X				X
Increased diseases outbreaks	X			X	
Increasing digitalization		X	X		

Challenges are interrelated and some of them are the causes and the others the effects (Figure 1). The low profitability of the sector is the result of the increasing production costs (especially to the feeding costs) and the low and stagnated lamb prices (around 7€/kg). The decreasing of lamb national consumption explains the prices stagnation. In turn, consumption declining is explained by the bad image of the livestock industry (animal welfare, gas emissions, etc.) and the changing consumers' preferences for other types of meat (chicken, pork).

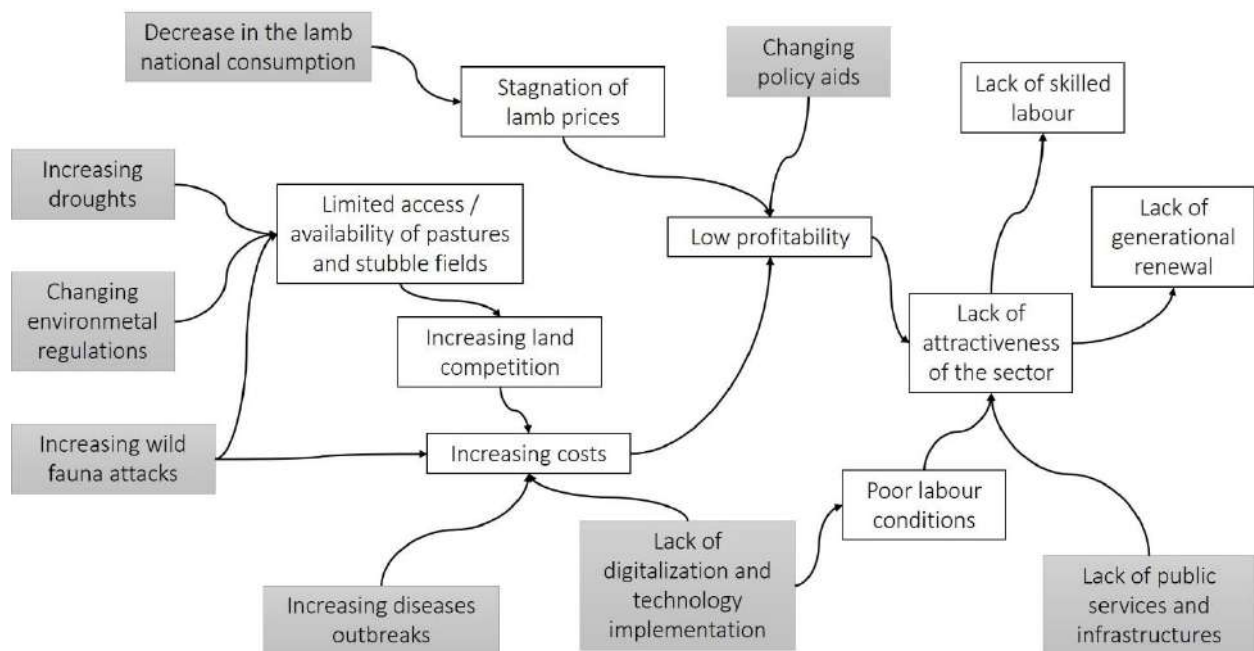


Figure 1: Scheme of the relationships between challenges in the extensive sheep farming in Huesca, Spain. The challenges in grey are the identified as root causes.

An additional challenge is the limited access and availability of pastures and stubble fields, Traditional grazing lands are currently dedicated to more profitable uses (e.g., irrigated crops), increasing the competition to access to pasturelands. Moreover, crop farmers deny the herds to access or passing through their lands, and the public administration limits the access to certain protected areas. Additionally, increasing droughts are diminishing the productivity of the pastures. Finally, the increasing presence of wild fauna (wolves and bears) is leading farmers to anticipate the risk of potential attacks and limit the shepherding movements.

Isolated diseases outbreaks are considered as shocks that affect directly (because of heads losses) and indirectly (because the increase of costs) the profitability of the sector.

Changes in the agriculture policy are classified as trends as the extensive ovine sector depends greatly on the public aids. The coupling of aids to hectares have negatively affected farms incomes. Farmers in the region who do not own hectares and have no capacity to rent them, have seen their aids reduced since the payments decoupling. European, national and local legislation add greater pressure in the issue of accessing to land when they limit the access to protected

areas (e.g., Natural Parks legislation), protect wild fauna or support the expansion of urban areas in the region.

The population in the region has drastically decreased in the last two decades, due to the lack of work opportunities in a region where the agriculture has been the main economic driving force. The depopulation of the region has been accompanied by a decrease in public services (schools, medical centres, etc.). Moreover, the low profitability and quality of life of the sector (mainly because the time consuming and hard conditions) has led to a low generational renewal.

All these challenges affect in the first place to the provision of private functions of the system, as the production of meat, income generation and employment creation. Indirectly, when sheep census and farms decrease in the area, public functions are also affected because the maintenance of natural resources decrease (pasturelands are not grazed), and the public facilities and services are less and less frequent in the region (due to its depopulation).

3 Response analysis

3.1 Decreasing national lamb meat consumption

Impact on FS functions

The decrease of lamb meat consumption has been caused by several factors. The urban trends in relation to meat consumption seems to condition the lamb meat market: vegetarian and veganism diets, trends in low meat consumption diets (related to health and environmental impacts of livestock sector) and the preference of other types of meats, as pork and chicken (cheaper, less tasty and easier to cook) (Corcoran, 2003; Martin-Collado et al., 2019). These trends could have been influenced in turn by the negative image of the livestock industry in the social and mass media. The national lamb meat consumption decreased by 40% in the period 2006-2017 with a current value of 1.3 kg/inhabitant/year (MAPA, 2018).

The decreasing lamb meat consumption lead to lowering lamb meat sales followed by a negative impact on the provision of private functions. According to SURE-Farm FoPIA2 results, the gross margins are somewhat close to the tipping point. The number of farms in the region also seems to be at the tipping point. It has decreased around 60% in the period 2005-2015 (Gobierno de Aragón, 2016). The potential impact of this challenge on the profitability of the farm and the employment generation is equal to the actual impact.

The closure of farms has led to the decrease of sheep heads in the region, negatively affecting other private function of the sector, the production of food. However, the decrease in the ovine census has not been so acute comparing the number of farms, because the remaining farms increased their size. In this sense, the sector shows certain resilience as the actual impact on the food production is still somewhat far from the tipping point (potential impact).

As a consequence of the decrease in the number of sheep in the region, the public function of the FS related to the conservation of nature is reduced in some extent because of the decrease in the number of sheep that graze. Similarly to food production, the actual impact in the public function is lower than potential impact as the decrease in the ovine census has not been so accused as it could be.

Anticipating capacity and actions

The sector did not anticipate the national decrease in lamb meat consumption. The trend of this challenge has been slow and hardly noticed and predictable in the long term. Data show a downward trend since the beginning of the century, but the decrease could have started earlier. The capacity of anticipation regarding this challenge was limited because the actors in the sector had not undergone it before. Ancient farmers did not mention they had to deal with this challenge before. Besides, the low profitability of the sector has led to actors to pay attention on short-term challenges instead of imagine possible future trends.

We surmise the FS actors (farmers hereafter) could have better anticipated the decrease of lamb consumption, as they were aware that the rural population was the main consumer of the lamb meat and rural population was already decreasing.

Coping capacity and actions

As the impact of decrease in the lamb meat consumption on the FS functions is remarkable, strategies seemed to be not sufficient. **Farmers** are the actors that have contributed the most to the robustness of the system in order to maintain/improve the farms' profitability. The first reaction of farmers was the use of savings. Besides, the maintenance of low levels of debts were necessary to face the lack of solvency. Thus, farmers who implemented economic measures were able to survive, whereas farmers with no savings disappeared. Farmers have diversified the distribution channels encouraging local sales and short channels and or exports.

Other farmers opted to increase the benefits by reducing costs and increasing productivity with strategies in which farm efficiency was improved. For instance, some farmers shifted to more prolific breeds or implemented new insemination methods. Others opted for more efficient feeding systems simply by selecting the quality of fodders or with more sophisticated techniques,

as the *Unifeed*, a feeding technique based on a mechanical system to ensure balance feed. There have also been improvements in the herd management (e.g., handling facilities). To improve the sales, others farmers opted to boost the quality and the attractiveness of the local breed (*Ternasco de Aragón*) by using origin certificates and labels.

The number of sheep has not decrease as fast as expected in the last years because the remaining farms have increased their size offsetting in part the reduction of the number of sheep (because of the acquisition of units from closed farms). However, the increasing of farm size did not stimulate the growth of contracted workers in the region, as family members manage the farms adding extra labour, and therefore, the function of employment creation has not been improved because of the sheep heads purchase.

The financial institutions and cooperatives from the **enabling environment** provided farmers financial products to cope with economic problems. Cooperatives and distributors also offered new production contracts to improve the producers benefits and their bargaining power. Cooperatives and producers' organizations also strengthened cooperation between farmers and other actors in the value chain (distributors and slaughterhouses). Policy makers have recently guaranteed the farmers' bargaining power with new legislation (*Real Decreto-Ley 5/2020*).

AKIS actors, together with cooperatives, participate in the research of more prolific breeds, as well as sanitary measures to guarantee the animal health. New research was accompanied by technical support (referred to animal management and use of the new technology and techniques), provided by cooperatives, advisers, services providers (veterinarians) and distributors.

Producers' organizations and cooperatives have helped farmers in the certification process, labelling and bureaucracy, whereas policy makers, assisted by the AKIS domain, have adapted legislation and requirements for the certification and labels (i.e., sanitary measures, employed breeds, etc.).

Other coping strategies have been implemented by the enabling environmental in order to promote the consumption of lamb meat. Cooperatives played an important role, together with the local and national institutions, by leading marketing campaigns and enhancing public awareness about the healthy virtues of lamb meat (especially the certificated and labelled products) against other types of meat and the contribution of the sheep extensive sector to the conservation of the environment.

Responsive capacity and actions

Some **farmers** have responded to reduced sales diversifying the farm with new activities, such as almonds, olive trees plantations, cereal crops, etc. Others have generated new incomes with off-farm activities (e.g., agri-tourism). Lastly, others have shifted to more profitable sectors, such as the calf fattening.

The **enabling environment** contribute to the transition to other sectors by providing different resources. The producers' organizations and cooperatives support the connection between actors, and provide training related to the new activities. AKIS actors (CITA/ Universidad of Zaragoza) also provide information of agricultural sectors' profitability, to support the farmers' decision making. Financial institutions provide economic support for activity diversification. Local administration help farmers to find off-farm jobs.

Enabling or constraining resilience attributes.

While the function of quality food provision has been somewhat supported by an attribute of "Self-organization" (actions taken by cooperatives/POs), potential adaptations or transformations to boost economic viability have been hindered by a lack of a "Reasonable profitability" by the farmers' side, and weak "Diversity in Policies" to tackle the complex socio-economic phenomena of reducing lamb demand.

3.2 Changing policy aids

Impact on FS functions

The profitability of the farms strongly depends on the aids from the CAP. The decoupling of the payments led to a reduction of the aids perceived by farmers. Farmers in the FS seem not to agree with payments by hectare as they do not own land and they have to pay high rents to get them. According to statistics (European Commission, 2020), the average aid received by farmers in the region is around 24 €/head. According to SURE-Farm FoPIA2, the perceived aids are insufficient and close to their tipping point, i.e. if aids continue decreasing, the farms' gross margin will become negative and more farms will be closed within a time period.

The most affected function by changing policies is the profitability of farms, as the earned incomes decline inexorably. However, the resilience of farms to the decreasing aids depends on the farm, as not all farms receive the same type/quantity of aids. First, farmers established long time ago receive "historical payments" which are not perceived by new entrants. Second, farmers who own/rent more hectares receive more aids. Third, farms located in less favoured area (LFA) (mid-mountain areas) receive additional aids. The disparity of perceived aids suggests that the actual

impact of changing policy aids on the sector profitability is lower than the potential, as some farmers have been more resilient than others.

Anticipating capacity and actions

Farmers and other actors have not been able to anticipate this challenge. Although this challenge is perceived as a trend because of the continuing changes in the aids perceived, CAP reforms are periodic and, in a certain way, predictable. Farmers could have learnt from the former CAP reforms and anticipate the impact, but it failed to do so.

Coping capacity and actions

A first reaction of **farmers** to decreasing aids was to reduce costs and take advantage of economy of scales by enlarging the herd size. Additional coping strategies were to use their savings and keep low indebtedness level.

Responsive capacity and actions

Some **farmers** diversified their incomes with on-farm and/or off-farm activities. The **enabling environment**, with the support of PO, cooperatives, financial institutions and the public sector, contributes to diversification by providing information and funds and encouraging knowledge exchange.

Enabling or constraining resilience attributes.

The lack of “Reasonable profitability” affected this farmers’ capacity, whereas policy makers missed an opportunity to strengthen the “Diversity in policies” and “Legislation coupled with natural and local capital” to boost extensive sheep farms’ potential.

3.3 Limited access/availability of pastures and stubble fields

Impact on FS functions

The limited access to pastures and stubble fields have a direct impact on the profitability of farms. Farmers have to pay increased rent prices to access pasturelands and/or have to increase the feeding costs as the animals cannot be fed with natural resources. In addition, land prices is getting higher as the increasing competence.

Another function affected by this challenge is the conservation of the environment through pasturelands grazing (public function). The hindrance to access to lands leads to decrease the contribution of the extensive sector in the environmental and landscape conservation.

The impact of this challenge on FS functions depends on the location of the farm. Farmers located in the Southern and flat areas are surrounded by irrigated crop lands. As a consequence, farmers have limited access to stubble fields and limited movements searching pasturelands and are forced to supplement the herd's diet. Farmers located in the mountains are surrounded by pasturelands, which are more accessible and only limited in some extent by the protected areas.

Therefore the actual impact in the farm profitability is lower than the potential impact, as the farms located in the mid mountains areas are not so limited in the access to pastures and stubble fields. The actual impact in the environment conservation is still far from the potential impact of the challenge, corresponding to a total limitation in the access to pastures and stubbles fields and the extensification of the sheep farming would not be possible.

Anticipating capacity

Farmers could have perceived the increased frequency and severity of droughts, especially in the summer. However, actions to cope with increasing trend of droughts did not occur. The wild fauna attacks started, once protection measures and repopulations began. Policymakers could have predicted the conflicts between livestock sectors and the wild fauna, and therefore, they could have developed measures for compensations before farmers requested them.

Crop farmers limit the passing of herds through their lands because of the incompatibility of different activities in the lands to perceive aids (e.g., fallows declared to be of ecological interest and susceptible for Greening aids, are incompatible with the grazing). Policy makers could have anticipated those conflicts, especially in Mediterranean areas where pasturelands (mainly located in the mountainous areas) are scarce, and livestock are also feed with stubbles.

Farmers could have anticipated that the access to lands will be challenging in the future but the anticipation has been limited, mainly explain for the lack of solvency preventing the acquisition of agricultural land.

Coping capacity and actions

To cope with the limitation in the access and availability of lands, **farmers** spent on fodders and grains in order to feed their herds. Contrary to grazing pastures, which is a free resource for feeding the animals, other feed systems are more costly and diminish farm's profitability. To avoid the expenses on fodders and grains, other farmers decided to rent the lands in order to access to

pastures. Both nourishment and rentals entail extra costs, which farmers settled using their own savings. Increasing the land extension is an important strategy for sheep farms' profitability. However, for those farmers who could not access new land/pastures, the main coping strategy was increasing the feed purchased, changing the balance between on-farm and off-farm feed production.

In order to improve the access to lands, some (livestock) farmers and crop farmers have reached agreements to occupy the lands for grazing. Others recently have started to use technology (e.g., drones, satellite images) in order to easily locate the best and available pasturelands, or monitor the presence and movements of the wild fauna.

In relation to the **enabling environment**, financial institutions offered financial support to cope with costs related to feeding and rental of lands. Some insurance companies have provided farmers some pasturelands insurances covering costs of supplementary feeding consequence of the droughts. Despite being presently available an insurance line offered at subsidized rates, few farmers contract it because the way insurance premia and contract are defined do not their specific needs.

Producers' organizations have started to lobby the administration (policy makers) to improve legislation to facilitate the access to lands. Some projects are coming up to implement the use of drones and GPS devices to guide the herds to productive and less accessible pasturelands, where AKIS actors, policy makers and financial institutions are involved.

Responsive capacity and actions

Some **farmers** have decided to switch their activity to other agricultural sectors, such as intensive livestock farming (pork, chicken, and beef). This sector has grown in the region in the last years mainly because as it provides higher profitability and better quality of life and does not require to access to land. Other farmers have diversified their activity with on-farm and off-farm incomes. In any case, response strategies are linked to important financial outlays, and therefore, only solvent farms have been able to perform those strategies.

Enabling or constraining resilience attributes.

The limited access to land casts light on other actors that could contribute to overcome the challenges, such as crop farmers, who are currently in conflict with sheep farmers. This highlights the lack of "Appropriate connection with actors of other systems". Transitions to other sectors have been possible in more profitable farms. However, the attribute "Reasonable profitability" has been generally weak across the system. On the other hand, the attribute "Reflective and shared learning" have allowed farmers for improving pasture management and the efficiency in

using such resource. Being the linkage to natural capital an intrinsic feature of extensive sheep farming, the weakness of “Legislation coupled with natural and local capital” provided by policy-makers appears evidently with regard to the challenge of accessible lands and their sustainable usage.

3.4 Wild fauna attacks

Impact on FS functions

Occasional wild fauna attacks started occurring in the region in the last years, as a result of the implementation of protection measures and conservation strategies of the wild fauna. On the one hand, the Spanish strategy for the conservation of brown bear (*Ursus arctos*) in the Pyrenees and regional measures have led to the increase of their population and the southwards shift of their area of distribution in the last years. This shifting has given rise to conflicts between human and bears, in general related to the attacks to livestock in the mountains, causing the demand for measures to the local government by region’s inhabitants. Moreover, the wild fauna repopulation in limiting provinces involves conflicts between administrations (i.e., Aragón with France and Catalonia) because the animals freely move across the regions.

The wolf packs (*Canis lupus*) are also benefiting from a strategy for its conservation. Different from the brown bear, this strategy is also referred to the wolf’s management by hunting in the north of the country, due to the historical conflicts with the extensive livestock (in other provinces hunting is allowed for wolf management). The wolf disappeared in the Pyrenees at the end of XIX century, and until 2014, no wolves’ packs were registered in this mountain range. Since 2017 wolf have reappeared, causing around 500 attacks in the province between 2017 and 2019. However, attacks have not been produced by the Iberian wolf (*Canis lupus signatus*) but for specimens of the Italian wolf (*Canis lupus italicus*) coming from Italy.

The most direct impacts of the wild fauna attacks in the sector are the decrease in the production of lamb meat (because of heads losses) and the consequent decrease in the farm profitability. The presence of wild fauna also might decrease the quality of life of farmers because they need to spend more time protecting the herds. The presence of wild fauna might also prevent farmers from shepherding, and therefore, reducing the contribution of the sector to the environment conservation (public function). At this moment, the wild fauna attacks did not cause an important impact in the private functions of the sector, as the attacks have been rare so far. Besides, the impact of this challenge is not equally distributed in the province of Huesca: the farms located in the mid-mountain are more vulnerable to suffering the wild fauna attacks than the farms located

in the southwards flat areas. Therefore, the actual impact of the challenge in the private functions is limited, as losses of herd's units are not so numerous that lead to negative profitability of the farms. However, the contribution to environment impact is somehow closer to the potential impact as the only presence of wild fauna in the region might prevent the shepherding, and consequently the grazing.

Anticipating capacity and actions

This challenge is an example of the **farmers'** anticipation capacity, as actions are taking place before the shock actually affect the functions of the sector. Farmers are worry about the increasing presence of the wild fauna and predict the impact on the farms could be irreversible. For this reason, farmers have started to use electric fences that prevent the attacks. Moreover, they have created an institutional movement against the wolf and bear (*Plataforma contra la presencia del lobo y oso en Aragón*), to lobby the local government to prioritise the extensive sector over wild fauna, and protect the extensive livestock sector by monitoring of wolf and bear populations.

In the **enabling environment**, the local government, AKIS domain and environmental NGOs backup the cohabitation of the livestock and wild fauna. For this purpose, the project LoupO have been driven (between France, Andorra and Spain), which consists on the monitoring and tracking of the two species in the Pyrenees, and the acceptance by the inhabitants. Other projects are trying to demonstrate the use of drones for the herds' management. Besides, subsidies have been launched in 2018-2019 for the acquisition of electric fences, shepherds dogs and other measures for the herds' protection. However, as a gesture of open protest, some farmers did not apply for the subsidies because they consider them inadequate. Meanwhile, protests continue in the region.

Enabling or constraining resilience attributes.

Farmers and cooperatives have shown "Reflective and shared learning", through the capacity to foreseen the wild fauna threats by observing this phenomenon in other regions. Farmers have been implementing measures to adapt to the oncoming challenge. Policy-makers have provided weak "Diversity in policies", although some alternative measures were delivered (e.g. compensation payments for wolf attacks, next to legislation on wolves' protection). There is however a lack in "Appropriate connection to other actors", such as supply-chain stakeholders, NGOs and media, to face these challenge. For example, instruments provided by financial institutions were not tailored on actual farmers' needs.

3.5 Diseases outbreaks

Impact on FS functions

Some diseases affect the sheep sector, as the brucellosis, the foot-and-mouth disease, and the “scrapie” disease. In this report, we are going to focus in one disease: the “blue tongue” or “ovine flu”. This disease is caused by a virus and transmitted by a mosquito, and involves mucosa’s inflammation, fever and death (mortality rate of 2-30%) on the sheep. Although it has been almost eradicated in Europe since the sixties, some outbreaks arose in the last years. In Spain, the central government has stated as mandatory several vaccination campaigns during the last years. In 2008 a source of contagion was detected in Aragón and it was fought with mandatory vaccines. Those vaccines seemed to be the cause of animal losses because of metabolic disorders. It seems that the disease is under control and Aragón (and almost the entire country) is a free blue tongue region since 2015.

When occurring, diseases have an impact in the number of sheep, because of the dead or sacrifice of the animals, and the resulting decrease in the food production and farm profitability. Moreover, profitability is affected by the costs of the prevention (e.g. vaccines) and treatment measures. Other secondary effects (e.g., vaccines problems mentioned above) cause the decrease in the sheep census and profitability. In the case of the blue tongue, farmers suffer restrictions in the international markets if a disease outbreak is detected, causing problem to sell their production and profitability losses.

In the region, the actual impact of the diseases outbreaks in the profitability and number of sheep is lower than the potential impact, because of the strategies carried out to reduce the negative effects. Moreover, the diseases did not affect the farms in the region in the same extent.

Anticipating capacity and actions

This is a case in which a shock is being anticipated based on the previous experiences. Some of the former strategies carried out by the sector currently work as anticipation actions to prevent future outbreaks. In fact, presently farmers in the sheep extensive sector do not consider diseases outbreaks as important as other challenges. The decrease in the concerns might be related to the measures adopted in the past.

In general, **farmers** meet sanitary requirements (e.g., vaccines) and improve the feeding of the herds to increase the immunity against diseases. Facing the recent focus found in France, farmers in the region are taking more preventive measures, particularly in order to avoid market restrictions in case of the focus shifts from France to the region (their most important concern).

In the **enabling environment**, veterinarians played an important role in the sanitary measures carried out by farmers. The AKIS sector provide new sanitary tools (vaccines) and protocols. Insurance companies offer disease insurances to farmers to cope with diseases outbreaks in the future. However, according to insurance companies, the number of insurance contracts to covering animal diseases has decreased because of the confidence that farmers place on the vaccination campaigns. Insurance companies claimed farmers to ensure this shock now that the risk is low. If the breakdown appears it will be too late to be insured. At the same time, insurance products do not cover the diversity of the diseases that the farmers are asking for.

The Spanish Government has elaborated a plan to monitor, control and eradicate the blue tongue disease (updated in 2020), as well as encourage the vaccination campaigns. The local government is also carrying out monitoring programs and providing subsidies to create and maintain groups of experts who supervise the livestock health (*Agrupaciones de defensa sanitaria, ADS*). Producers' organizations have emerged as important actors in the management of diseases outbreaks. They intermediate with Public Administration insurances to cover future diseases outbreaks. They also lobby to declare the vaccination in Aragon as voluntary (only mandatory if cases exist in the region) because of the problems of metabolic disorders in the past.

Enabling or constraining resilience attributes.

It appears that there has been an "Appropriate connection between farmers and multiple actors" (including also consultants, financial institutions, and administrations), and a sufficient "Reflective and shared learning" among farmers, which made them able to take some preventive actions. In addition, consultants have also played an important role by guiding farmers' actions with respect to sanitary techniques.

3.6 Lack of public services and infrastructures in the region

Impact on FS functions

The depopulation process in the region since the last century (Ayuda and Pinilla, 2002) has been accompanied by a decreasing availability of public and social services (schools, health centers, etc.) and decreasing investments of the private sector, which does not perceive the region as a good location to establish their businesses.

The scarcity of public services and private investments make the region less attractive to live, and consequently limit the entrance of new people and workers in the extensive sheep sector. The

most affected private function by this challenge is the employment generation. Many farms are closing as there is a lack of new entrants and familial successions.

The actual impact of lack of services and infrastructures in the region in the employment generation function is equal to the potential impact, as the number of farms and people in the region is critical. Nevertheless, although the actual impact of this challenge on the provision of quality food and environment conservation is high, there is still room to manage it.

Anticipation capacity and actions

The anticipation of this challenge has not been produced. Similar to the decrease in the lamb consumption, this challenge has been slow and went hardly noticed, at least at the beginning, leading to late reaction. The policy makers are the actors with the capacity of anticipation because they own and compile the information (data, statistics) of the social situation of the region. Moreover, administration has access to the capital (financial, infrastructural, and legal) to tackle the problem of the lack of services. Some rural development programs were carried out before the lack of services and infrastructures were truly challenging; however, they were scarce and ineffective to boost the economy and social structure of the region. Other actors belonging to the enterprise domain, due to the lack of administrations' involvement, did not consider to invest and undertake their business in the region.

Coping capacity and actions

As the most impact of the challenge is on the scarcity of workers in the region, the sector needs to increase the workforce. A common coping reaction by **farmers** was to adjust the flock size based on the available family work (usually between 800 and 1200 heads). This process started occurring approximately 15-20 years ago. Later on, to overcome the challenge farmers tried to take other actions, as the appeal of foreign workers, mainly from Romania, Morocco and Poland. In order to improve the quality of life in sheep farming, and to reduce the time demanded by grazing activities, some farmers started to implement technologies and innovations on pastures.

In the **enabling environment**, rural development programs were design to improve the quality of life in the region and attract new people and workers. However, the results of those programs have been insufficient. Cooperatives with the support of public administration pursued the creation of the school of shepherds, to foster the shepherding knowledge transfer between farmers. However, this initiative did not catch on. Services providers have offered technologies and training to the farmers, whereas financial institutions have provided the financial support for its acquisition.

Responsive capacity and actions

The main response strategy of this sector facing the lack of services in the region is the shifting of **farmers** to other sectors, specifically to intensive livestock sector. This sector is compatible with an urban life style because the work activity is not as time consuming as in the extensive sheep farming and farmers are able to move to the city to live, where more public and private services are available. The **enabling environment** helps farmers in the transition by providing information and training related to other sectors (AKIS actors and producers' organizations) and economic support.

Enabling or constraining resilience attributes.

This challenge is characterized by manifold, different socio-economic and institutional phenomena and aspects which need to be tackled through joint actions by different actors. Nevertheless, the farmers are not "Appropriately connected to other actors" to face the threat. Despite some measures were implemented by policy-makers, attributes of "Infrastructure for innovation" and "Diversity in policies" seems weak. Besides, there has not been sufficient effort by media, consultants AKIS' actors to cope with these phenomena, though attention was paid at the issue during the last decades. The lack of services and infrastructure in the region, indeed, affect all actors, and would require efforts by all of them.

4 Pattern analysis

The objective of this section is to find patterns of previous analyses and classify them in the system archetypes (Kim, 1992), which represent systematic issues and possible solutions.

The challenges in the FS related to the reduction of lamb meat consumption, the limited access/availability of pastures/stubble lands and the lack of public services/infrastructures in the region are classified as long-term changes. We can see that these trends were not perceived at the beginning by farmers but became important as time went by. These trends correspond to the **"drifting goals" archetype**, in which the system does not respond to the trends as long as the impact is not felt (the gap between the desirable state and the current state of the variable becomes greater and greater, leading to the system's instability). When the system is able to perceive the impact of those challenges, the gap is so large that the measures/strategies to reduce it are scarce or ineffective (**"fixes that fail" archetype**). In the case of limited access/availability of pastures/stubble lands, some kind of anticipation was perceived by farmers, however, the lack of profitability in the sector resulted in no actions. Moreover, the drifting goals of one challenge trigger the drifting goals to other challenges. For instance, the depopulation of the region have led to the lack of services in the rural areas, and vice versa.

In relation to the decrease in the lamb consumption, the gap between the goal of sales (the value of sales necessary to properly maintain the sector) and the actual sales has increased (Figure 2). The pressure of the society has led to the decrease of the sales goal and the increase of the gap. In order to increase the actual sales and reduce the gap, the sector have implemented some strategies. However, the majority of those strategies have been oriented to reduce production costs, which have not mitigated the sales gap. Some strategies, as the consumption campaigns, tried to reduce the pressure, but they were insufficient and the gap has not been reduced.

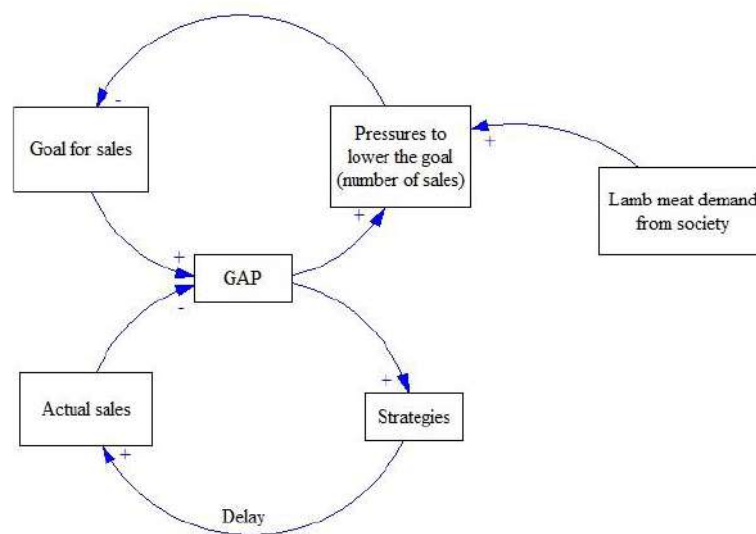


Figure 2. Lamb meat consumption “drifting goals” archetype.

In the case of limited access/availability to pasturelands and stubble fields, the sector tried to reduce the gap with strategies related to the increase of feeding costs (which could imply intensification too) or exiting the sector. However, strategies to improve the access to the lands have not truly carried out, for example, a strong lobby that pressures the policy makers to change legislation and regulations related to the access.

To alleviate the lack of services and infrastructures in the region, some measures (e.g., rural development programs) have been implemented by the administrations. The goal was to avoid the progressive depopulation of the region, the most important trigger of the decrease in the services. However, those programs have not been effective.

Regarding shocks (diseases outbreaks and wild fauna attacks), the sheep extensive farming the sector has responded with more or less effective measures that have alleviated the impact of the challenge, and even controlled it (i.e., diseases outbreaks). In relation to wild animal attacks, FSS’ actors are willing to take measures, not only to solve economic problems (e.g., to apply for aids

because of animal losses), but also to solve the problem of the livestock-wild fauna conflicts, in which policy makers play an important role. Thus, the risk of the failure of one solution decreases. However, not all the measures have succeeded (**“fixes that fail” archetype**). For example, farmers do not take out drought insurances, as they are perceived as failed products.

In general, the trends and shocks have a final effect on the profitability of the farms. The sector followed a program of aids to overcome the lack of profitability. It was expected that aids were a solution to relieve the financial problems of farms. Now, that the aids are decreasing, it can be seen that the challenge of reduced profitability is still there (**“fixes that fail” archetype**). The aids solve the symptom but not the cause of the low profitability, leading to the sector’s dependency on external inputs. This situation fits in a **“shifting the burden” archetype**, in which public institutions parch up the problem improving the solvency of farms whereas the challenges causing the lack of profitability (mainly the trends) are not addressed (Figure 3).

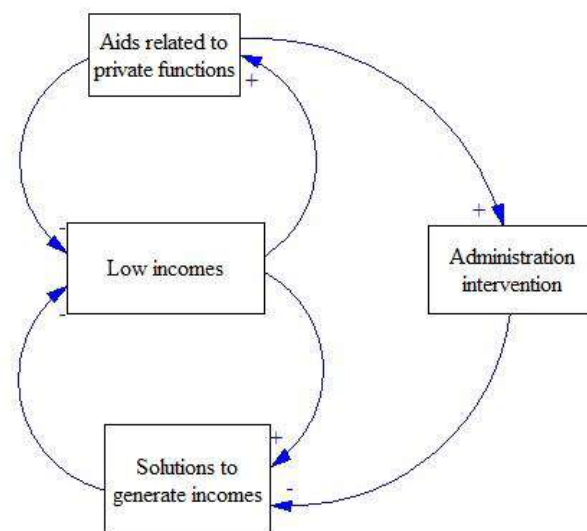


Figure 3: Shifting the burden archetype

Most of the strategies carried out in the sector were oriented to improve the robustness of the system (coping strategies). In fact, the perceived aids prevent FS’s actors taking measures for the sector adaptation and transformation (Figure 3). The trend of meat sales continues to its gradual decrease and the measures to revitalize lamb meat consumption have not been that effective. Therefore, the sector needs to generate incomes, not only from the meat sales, but also from the provision of other type of services, eventually eliminating the dependency of the current public aids (related to the provision of private functions). The management of permanent pastures and landscape features by the extensive sheep FS, reflected in the future Eco-schemes of the CAP

reform (2021-2027) could contribute to farms incomes. The administration could recognize this contribution via public aids (Figure 4).

The maintenance of pasturelands by sheep grazing helps preventing shrub encroachment, and therefore, the increase of wildfires risk, and to increase pastures biodiversity, among other ecosystem services. Improving nature conservation leads to a better societal perception of the sector, which might perceive the lamb meat as a sustainable food and be more willing to consume it. The increase in consumption leads to greater incomes from sales in the sector (Figure 4).

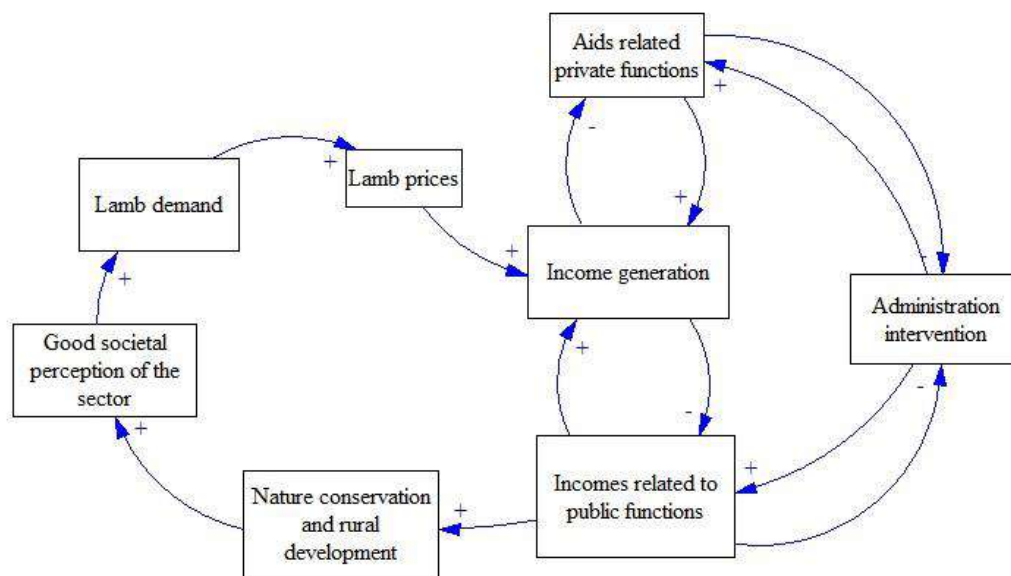


Figure 4: Capacity of incomes generation.

As a summary, this is the pattern of challenges: the trends share the same type of archetype (“drifting goal”), as the system is not able to detect the impact of the challenge at the beginning. When the impact on functions is detected, it is so great that the measures performed by the FS are inefficient or insufficient. In general, strategies carried out to decrease or solve the trends’ impacts fit in the “fixes that fail” archetype. Among those failed strategies are the public aids, which have exacerbated FS’ dependency on them and discourage out strategies to tackle the cause.

As a summary, this is the impact on FS functions: the challenges seem to have a greater impact on private functions than on public functions. The most important function affected by the sector’ challenges is the profitability of the farms. In turn, the decrease in the farms’ profitability leads to the closure of farms (employment generation) and the drop of the number of sheep in the region

(provision of meat). As consequence of the strategies carried in the FS, the decrease of the sheep census has not been so acute, and consequently the impact on the food production and in the contribution to the environment conservation was lower than might have been otherwise.

Contribution of the FS resilience attributes to strategies

In the extensive sheep sector, the scarcity of some resources and characteristics have led to the failure of most of the performed strategies. There is a lack of economic resources, as the sector's profitability is very limited, but also of human resources, as the workforce in the region is limited. The lack of resources have conditioned the behavior of farmers and other actors, which showed low confidence and attitude to invest in risky strategies. Moreover, although relevant, cooperation between actors has not been decisive for the success of many strategies. All those deficiencies are related to some of the sector's resilience attributes "Appropriately connected with actors the farming system", "Exposed to disturbance", "Reasonably profitable", and "Infrastructure for innovation"), which have contributed negatively to the robustness of the system against the challenges. The lack of "diversity of policies" resulted in the low response of the policies to the singularities of the sector. Additionally, the "lack of legislation coupled with local and natural" has complicated the contribution of the sector to the environment conservation and the "coupling of the sector to the local and natural capital" resilience attribute. The coupling with local and natural capital has been weak so far, but it shows potential for the future given the intrinsic linkage between sheep farming and natural resources, which future policies might address (e.g. Eco-schemes in CAP post 2020). However, other resilience attributes have positively contributed to the sector's resilience. For instance, the "spatial heterogeneity" attribute of the extensive sheep farming have contributed in a positive manner as it made some challenges (e.g., the wild fauna attacks) did not impact so strongly in some areas of the region. Furthermore, "socially self-organized" and "reflective and shared learning" have shown positive contribution to some strategies, like coping with reducing lamb demand and lack of working force, and improved land management.

Actors, actions and resilience attributes

Table 3 summarizes the actions performed by the actors on the different domain regarding the challenges, and the resilience attributes they strengthen. In general, most of the actions are centered in the business domain. It enhances the "reasonable profitable", "functional diversity", "infrastructure for innovation" and "builds human capital". The government domain, mainly promotes the "diversity in policies", especially the legislation related to fairness in the value chain and environmental protection measures. Policy domain also contributes to "appropriately connected with actors", "reflective and share learning" and "exposed to disturbance". The

intermediary (producers' organizations) domain enhances the connection between actors leading to better responses facing the challenges. So the intermediary enhances the attributes "appropriately connected with actors", the "exposed to disturbance" and "optimally redundant". The actions carried out in the AKIS domain enable the "reflective and share learning" and the "infrastructure for innovation". The participation of the societal domain is almost nil and its contribution to enhance the resilience of the FS is nor present.

Table 3. Actors, actions and the resilience attributes.

Challenge	Enterprise	Government	Intermediary	AKIS	Societal
<p>Decrease in the lamb meat consumption</p> <p>Changing policy aids</p>	<ul style="list-style-type: none"> • Savings and extra work (farmers) • Increase of farm's herd (farmers) • Knowledge transfer • Financial support (financial institutions) • New production contracts (farmers, cooperatives and distributors) • Increase of farm efficiency by decreasing feeding costs and increasing prolificacy: use of technology (farmers) • Technical support in the new technologies (cooperatives, services providers, etc.). • Research in new breed and technologies (cooperatives) • Promotion of origin certificates and labels (farmers, cooperatives) • Lamb meat favorable campaigns (cooperatives) • On-farm diversification • Off-farm diversification 	<ul style="list-style-type: none"> • Lamb meat public awareness campaigns • Legislation for quality certifications and origin labels • Legislation to boosting farmers' bargain power (policy makers) 	<ul style="list-style-type: none"> • Technical support in the new technologies (PO) • Boost of connection between actors (PO) 	<ul style="list-style-type: none"> • Research in new breed and technologies • Sector's information for diversification 	<ul style="list-style-type: none"> • Awareness of the sectors' contribution to environment
<p>Limited access / availability of pastures and stubble fields</p>	<ul style="list-style-type: none"> • Grains and fodders purchase (farmers). • Stabling of animals (farmers) • Rent/purchase of new lands (farmers) • Financial support (financial institutions) 			<ul style="list-style-type: none"> • Development of technology for pastures management • Sector's information for diversification 	

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	<ul style="list-style-type: none"> • Agreements between farmers for land occupation. • Use of technology for lands access (farmers) • Development and training on technology for pastures management (services providers) • Pasturelands insurances covering droughts (financial institutions) 				
Increase of wild fauna attacks	<ul style="list-style-type: none"> • Use of electric fences (farmers) 	<ul style="list-style-type: none"> • Projects for monitoring and tracking animals • Subsidies for protection measures 	<ul style="list-style-type: none"> • Lobby for the protection of the sector (PO) 	<ul style="list-style-type: none"> • Projects for monitoring and tracking animals 	<ul style="list-style-type: none"> • Acceptance of cohabitation with wild fauna
Diseases outbreaks	<ul style="list-style-type: none"> • Sanitary measures in the farms (farmers and veterinarians) • Diseases insurances (financial institutions) 	<ul style="list-style-type: none"> • Programs of monitoring, control and eradication, and vaccination campaigns • Subsidies for livestock health defense groups 	<ul style="list-style-type: none"> • Lobby policy makers for measures (PO) 	<ul style="list-style-type: none"> • New sanitary tools and protocols 	
Lack of services and infrastructures in the region	<ul style="list-style-type: none"> • Increase of farm's herd (farmers) • Hire foreign workforce (farmers) • Financial support (financial institutions) • On-farm diversification • Off-farm diversification 	<ul style="list-style-type: none"> • Rural development programs • Shepherds' schools • Labor legislation for foreign workers 	<ul style="list-style-type: none"> • Training in shepherds' schools (PO) • Boost of connection between actors (PO) 	<ul style="list-style-type: none"> • Sector's information for diversification 	
Resilience attributes	<ul style="list-style-type: none"> • Reasonable profitable • Functional diversity • Infrastructure for innovation • Builds human capital 	<ul style="list-style-type: none"> • Diversity in policies • Appropriately connected with actors • Reflective and share learning • Exposed to disturbance 	<ul style="list-style-type: none"> • Appropriately connected with actors • Exposed to disturbance • Optimally redundant • Builds human capital 	<ul style="list-style-type: none"> • Reflective and share learning • Infrastructure for innovation • Builds human capital 	

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D6.2 FRANCE

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Francesco Accatino¹

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1 FARMING SYSTEM AND ENABLING ENVIRONMENT

The region of *Bocage Bourbonnais* (hereafter referred to as Bourbonnais) coincides more or less with the French department of Allier, located in the Massif Central, in the centre of France. Agriculture is the dominant activity in the region and consists of extensive, grassland-based beef production systems, with about 483000 ha of agricultural land, being agriculture the dominant activity of the region. According to the last agricultural census (Agreste, 2010), the Bourbonnais counts 5523 farms, among which 3102 are beef farms. The region is not entirely occupied by permanent grassland: a portion of the region consists in crop cultivation and another portion is occupied by forest. The presence of crops contributes to self-sufficiency in the region, being a source of feed concentrate for complementing the diet of grazing cattle.

Historically and culturally the beef production is linked with the characteristic landscape, formed of meadows with a reticulate of hedges. In the past, hedges served to separate cattle herds grazing in different portions of grassland. Nowadays hedges are still a major object of conservation, because of the ecosystem services they provide (e.g., timber production, biodiversity refuge, wind-brakers). The Bourbonnais system essentially addresses three markets: a local short-value-chain market with local consumers and with often direct on-farm selling; a French non-local market (mostly for female cattle fattened in France); an export market mostly located in Italy, consisting of male weanlings transported to the Po Valley and fattened there to be sold on the Italian market. Table 1 provides a non-exhaustive list of actors involved in the farming systems.

Table 1: Actors in the French extensive beef farming system and its enabling environment (for illustration only, not an exhaustive list for the Belgian case-study).

Actors	Formal institutions	Informal institutions
Enterprise domain: Slaughterhouses, retailers, banks, insurance companies, veterinaries	Confederation des Paysans, Conservation associations (e.g., Mission Haies Bocage), cooperatives	Attitude to cooperation Attitude to retail
Government domain: European Union, French Ministry of Agriculture, French Ministry of Economy, Chamber of Agriculture of Allier, Department of Allier, Municipalities.	CAP, INAO (for label production)	Accountability Farmer participation Societal participation
Intermediary domain:	Interbev (inter-professional organization), FNB (Fédération	

Value chain actors for French non-local market, value chain actors for export market.	national Bovine), trade unions organizations	
AKIS domain: IDELE, INRAE, VetAgro Sup		
Societal domain:		Local consumers, Italian consumers, French non-local consumers, vegan movement

2 CHALLENGES AND ADVERSE EVENTS

The main challenges to which the Bourbonnais system was subject are summarized in Table 2.

Table 2: Actors in the French extensive beef farming system and its enabling environment (for illustration only, not an exhaustive list for the Belgian case-study.

Challenge	Typology
Increasing frequency of droughts	Trend
Increasing public distrust of practices	Trend
Demographic challenge (lack of successors)	Trend
Unbalanced value chain	Trend
COVID-19 crisis	Shock

Increasing frequency of droughts

Droughts constitute a major threat in the Bourbonnais, because they undermine the productivity of permanent grasslands, upon which the production of the whole farming system traditionally depends. In the last four years, three major drought events occurred. If a drought event in itself can be considered as a shock, this report refers to the “increased drought frequency”, which has to be considered a trend. No information on single drought events were available at the moment of the writing of this report. Droughts have been referred to as not only impacting the productivity affected in the specific event, but also as potentially having longer-term impacts, for example by harming at cow’s fertility. The farming system has already showed some signs of adaptation to this challenge mainly with strategies oriented at cultivating crops and storing feed, for increasing feed self-sufficiency (e.g. storing feed) or at buying external feed.

Public distrust from society

Public distrust and high societal expectations from farming practices are among the most serious challenges occurring in the region. The challenge is manifested in two principal ways: (1) low willingness to pay of French citizens for French meat, causing lowered profit for farmers; (2) direct

or indirect attacks in verbal form or via social media, diffusion of negative messages about beef farming. The co-presence of these two forms of manifestation makes the challenge particularly difficult to address: while farmers try to adapt their practices in order to meet social expectations (addressing (2)), they do not find the correspondent reward in terms of higher willingness to pay from costumers (because of (1)). It is important to notice that the what is called “society” is not necessarily referred to the same entity in (1) and (2) and not all “society” is harming the farming systems. Concerning (1), the part of society which is not willing to pay higher price for high quality French meat is in general referred to a set of consumers in general not linked with the farming system and not necessarily interested in agricultural practices (in table 1 they are referred to as “French non-local consumers”). This part of society can be referred to a set of consumers, simply not interested in good quality French beef and often preferring lower-quality meat coming from the dairy supply chain in the form of minced meat. Concerning (2), it is recognized that an increasing number of consumers are more and more interested in the environmental impact of farming practices and of food value chains and in animal welfare; the “louder” social groups – especially the vegan movements - are often a (*“minority that make much noise”* as said in an interview) , especially thanks to the social media.

What makes things more complicated is that farmers are already well convinced about the good quality standards of their practices. Most farmers subscribed a quality label (“Label Rouge”) and the participants to the FoPIA-SURE-Farm 1 workshop assigned a very high score to the performance of the function “animal health and welfare”. Other than that, actors of the farming system are well aware about the synergy between the grassland-based livestock system and the aesthetic quality of the landscape. Local consumers are aware too as demonstrated by the recent (pre-COVID) increase in direct on-farm selling. In fact, the interviews revealed that the problem of social distrust is essentially a problem of communication, as the high-quality standards of practices in the Bourbonnais are often not well-perceived nor communicated in the civil society: this also emerged from the interviews (*“I wish that consumers were more aware about our practices...”*).

Unbalanced value chain

A trend that puts the farmers of the Bourbonnais in conditions of stress is the fact that they are essentially weak parts of the value chain. The symptom that render this stressor manifested is a continuous and apparently unjustified lowering of beef prices and, therefore of the revenues of farmers. As a consequence, farmers are not in the condition to make a good living out of their jobs. During the interviews, some farmers declared that they are not in condition to pay the loan given by the bank at the starting of their activity, or simply pointed out at the gravity of the situation of low prices (*“...we do not choose the price of what we buy and we do not chose the*

price of what we sell. We lose 200 to 250 euros per animal. It's a huge loss, it's huge..."). The recent COVID-19 crisis rendered manifest this problem: during the first part of the crisis the demand for beef from the internal French market increased (because of a decreased concurrence with beef imported from abroad and increased demand of beef to eat at home). Paradoxically the prices of the paid to farmers for their cattle decreased. Although the demand was mostly referred to chopped beef (cheaper), it was recognized that the main cause of the lowering of price do not only lie in the low willingness to pay by consumers, but foremost in an unbalanced repartition of margins along the value chain.

Demographic challenge

The farming system is experiencing a lack of successors for the farmers that go on retreat. Although this trend has been occurring for the last years, the climax is likely to occur in the next years: the farmers population is ageing and not many people are willing to engage cattle husbandry in the Bourbonnais. On the one hand, descendants of farmers are usually attracted by other professions often in other regions, on the other hand some outsider are potentially attracted by becoming farmers but they are hampered by lack of skills and the high levels of debts to run into in order to start the activity. The region is facing this problem because it is paying a "baby boom affect": at the beginning of the 90's, as a response of some European policy measures, France encouraged many people to start their activities as beef cattle farmers. Nowadays, a high percentage of Bourbonnais farmers are approaching the retreat synchronically. This phenomenon is basically the manifestation of a number of other challenges which jointly lead to the difficulty of finding successors. These challenges are linked to the lack of attractiveness of the region in itself and of the cattle farming profession. The low level of profitability, the increasing frequency of droughts, the exposure to public distrust erode the willingness to becoming cattle farmers. This adds to the intrinsic level of difficulty of the profession, as highlighted in the interviews, linked to the high level of workload (especially to farmers having also crop fields – maybe distant - to look after) and the physical risks (cattle are big animals and sometimes accidents occur). Other problems are instead linked to the difficulty to find formed and professionalized farmers.

COVID-19 outbreak (and consequent lockdown)

The outbreak of COVID-19 of February 2020 constituted a challenge for the Bourbonnais as well as for the majority of European farming systems. The challenge came from the virus itself (risk of farmers and value chain actors to be contaminated), and from the lockdown measures (difficulty for farmers to go on the farm, decrease of demand due to closure of restaurants). Not less importantly, two major events of significance for the Bourbonnais farmers were cancelled. In 2020

the “Salon de l’agriculture” has less participation (and the last day was cancelled) and the “Sommet de l’élevage” was cancelled; next year, with high probability the “Salon de l’agriculture” will be cancelled. Those are events of big importance for farmers, cooperatives and their representants, because they have the opportunity to interact with the civil society as well as with other actors of the value chain.

3 RESPONSE ANALYSIS

3.1 Response to increasing frequency of droughts

Potential impact

Droughts potentially put the whole farming system at risk. By harming the primary productivity of grassland upon which the system is based, farmers will be forced to de-stock their herd and adjust them to the reduced resources available. It is to be considered that a part of the region is dedicated to crop production that might provide some supplementary feed, however also that part of the region is also subject to the same drought event. Led to the extreme consequences, droughts might cause the collapse of the whole system. The primary function of the system “Food production” will be largely reduced, causing also a reduction in the function “Economic viability”. The functions provided by the landscape (namely “natural resources” and “biodiversity and habitat”) will be also reduced, because the landscape is largely maintained by the livestock activity: a part of the grassland would not be anymore maintained by livestock grazing (and potentially it can be colonized by bushes) and hedges will not be maintained by farmers.

Anticipation

Despite the increase of the drought events, the farming system continued being able to deliver its production, both to the export market and to the internal French market. This demonstrated that the system is adapted, at a certain extent, to droughts. Adaptation comes from the response of the farming system to the frequent droughts and make the system ready to anticipate the individual drought event. The individual drought even is not anticipated or forecasted *per se*, however actors of the farming system take into account the possibility that drought events might arrive at each year and are more or less ready to cope with them. Anticipatory and preventive actions are done via storing feed (farmers and cooperatives) or by subscribing insurance schemes on fodder cultivations (farmers and insurance companies).

Coping

The potential impact do not occur in full because the system was able to adapt its structure, rather than to cope with the droughts without changes. When present, stored feed and subscribed

insurance schemes make it possible to cope with the drought. Other coping measures were done by buying feed from external suppliers. Resources implemented are thus mainly monetary and actors involved are farmers, cooperatives, and feed suppliers.

Responding

The response of the farming systems to the increased drought frequency occurs mostly by a diversification of farmers' activities and a consequent change in the landscape. According to what observed by experts and with interviews, farmers would mainly respond with one or more of these actions: (1) cultivating some temporary grasslands that could be cultivated more intensely (fertilized) and whose harvest can be stored; (2) cultivating cereals and fodder so that they can store the feed cultivated by themselves and they can diversify on the cereal market; (3) plant more trees for providing shelter to cattle and to stimulate "islands of fertility" in permanent grassland. Strategies (1) and (2) are also subject to droughts, but are less vulnerable and easier to insure, in addition they are a source of feed that can be potentially stored, lowering or cancelling the quantity of feed needed from external suppliers during drought events. Both strategies concur in changing the configuration of the landscape. The increase of the surface of intensively cultivated land subtracts space to permanent grassland and increases the use of synthetic fertilizer, hampering the conservation of "natural resources" and "habitat & biodiversity", two functions that historically and culturally are considered of primary importance within the farming system. It is also to be said, that the focus on cultivated land and on the urgency of droughts subtracts time and resources to the maintenance of hedges. Strategy (3) opens new avenue for diversification in agroforestry, at moment still poorly explored in the region, but with good perspectives of growth. In addition, agroforestry might have the potential to reduce the drought-induced gap.

3.2 Response to increasing social distrust

Potential impact

This challenge is particularly hard for the system in the long term. In order to meet societal expectations, farmers should increase their costs for improving practices and for maintaining the landscapes, but the extra costs are not covered by revenues. This impact is alleviated by two elements. The first element is the existence of the foreign market: the export of weanlings to Italy was maintained for about 30 years without major impacts: meaning that social distrust is not strong on that side. The second element comes from the local consumers: these consumers are well aware of the quality of beef production and on the already high animal welfare. In addition, interviews highlighted the feeling of discouragement of farmers due to the continued social distrust (*"You accuse me continuously, but I provide you food!"*). This sense of discouragement

lowers the attractiveness of the profession and in some cases provoked depression in certain farmers. Overall, the potential impact would be a lowering of the attractiveness of the farming profession in the region, causing a drastic reduction of the number of farms with the survival of only the most technical farms specialized on the export market and on some farms that satisfy a small local and niche demand. The reduced number of farmers will not be enough to ensure a good maintenance of the landscape, therefore, without other actors taking care of the landscape, there would be a degradation. It would be also possible that many farmers will convert their activity to crop farming, again, causing a possible degradation of the landscape.

Anticipation

This trend was gradually increased along time and it is difficult to speak about a clear anticipation. The interviews demonstrate that farmers are well aware and are already concerned about the increasing social distrust, but this refers to an ongoing process, not to the anticipation.

Coping

Because of its intrinsic configuration, this challenge forces the system to change. A coping mechanism regard the continuation of the export market, which seems less affected by public distrust, and on the local market. Other than that, a responding mechanism is required in order to maintain the economic viability of the farming system.

Responding

From farmers, the response to this challenge arrives in two ways. Farmers are in general in perspective of adapting their practices in order to meet social expectations *"We are going to adapt to them [the consumers], it will not be the other way around"*. Essentially, the practices should address the reduction of the environmental impacts (e.g., optimized fertilisation, reduced or stopped ploughing, and reduced use of pesticides) and improving the animal welfare. In this regard, the risk management workshop highlighted that, although farmers are the primary responsible of the changes in practices, they need the support of other actors. Actors of the value chain (e.g. feed suppliers, retailers) should support a better definition of prices, the cooperatives have a role of support in this. Contractualisation also helps in this sense: it consists in an agreement between a farmer and a seller in buying a certain amount of product at a pre-negotiated price. The Ministry of Agriculture and Alimentation introduced in December 2019 the obligation to engage contractual agreements with Label Rouge farmers, so to encourage the subscription of the certification scheme. Other actors should help the farmers by providing advice: this is the case for cooperatives, farmer advisors.

The passive adaptation to the consumers demand would probably not constitute the real fix to this challenge. Consumers are often not well aware about the practices, which are already of good quality. A more effective fix should pass by engaging a dialogue with the civil society, so that the practices of farmers become well known and raise better awareness among consumers. Some clues suggest that this strategy should be effective: the increase in direct selling demonstrate that local consumers, most in contact with the farming system, are aware of the good quality of the production in the Bourbonnais and are willing to pay the right price for it; the interviews reveal that farmers would like that consumers were more aware about their practices; last but not most importantly, the recent COVID-19 crisis registered a marked preference of French people for French beef, showing a raised awareness about the important contribution of French beef producers to contribute to a high-quality food provision. Regarding this later issue, data clearly show that in 2020 the prices of beef for French consumption increased in clear contrast with the trend of the previous years. These elements strongly suggest that the problem of public distrust is essentially a problem of (mis-)communication between farmers and the civil society.

A process of mutual listening between farmers (and value chain actors) and the civil society would benefit: farmers can be aware of consumers expectation and consumers can be aware about the efforts of farmers to meet their expectations and are willing to pay the fairest price for it. During the FoPIA-SURE-Farm 1 workshop, participants suggested that for improving the dialogue with the civil society a strategy is to “improve the image of the Bourbonnais”. However, this strongly needs the support of higher-level actors. In this direction some initiatives are being done. The inter-professional organization INTERBEV is facilitating the dialogue with the civil society along multiple levels of the value chain. One initiative is the “PACTE pour un engagement societal” (agreement for a societal engagement), where actors of the beef value chain engage in reducing their environmental impact (also enhancing the valorisation of permanent grassland), promoting animal welfare, acting for a fair remuneration of workers, and promoting good-quality dietary habits. Another initiative is the campaign of communication “Naturellement flexitariens” (Naturally flexitarian) with the slogan “love meat, eat it better” with the purpose of communicating principles of healthy diet with high quality products, including also meat. An action is to improve the access of farmers to the public market. The social acceptance of the practices also comes from the maintenance of the landscape. More and more farmers are subscribing to the certification scheme “label rouge” which includes and certifies practices of maintenance of landscape. Also, the grasslands are protected by policies, however, if farmers do not have the financial and time resources to maintain the landscape, the policy will hardly be effective. In the maintenance of landscape farmers should be supported by the enabling environment, composed by conservation associations and support at different administrative level.

3.3 Response to the weak role of farmers of the value chain

Potential impact

The symptom of the challenge, i.e., the low prices paid to the farmers for sold cattle, is the main driver of the impact of the challenge on the farming system. Low revenues would prevent farmers to make a living out of their activity and this would potentially lead to a reduced number of farms in the region. In 2019 about 1200 beef cattle farmers stopped their activity in France (counting retreats and failures) and this trend can be supposed to increase in magnitude given that a high number of farmers are currently in conditions of economic precarity. The reduction of beef farms in the Bourbonnais would cause land abandonment with the survival of only very technical and specialized farms for the export market or for local short food chains. It is not to be excluded that some farmers would convert their activity into crop production, which can be more profitable. The land abandonment and the conversion of grassland to crop cultivation would provoke an erosion of landscape causing the system to be less and less coupled to the natural capital and with increased use of synthetic fertilizers. The landscape degradation process would start even without land abandonment, because with reduced revenues farmers would not have financial and time resources to maintain hedges.

Anticipation

It is not possible to speak about anticipation in a process which can probably be described as a “boiling frog” (decreasing the goal archetype). The position of farmers within the value chain became weaker gradually with time, and, although the symptom (lowering of prices) existed for a long time, a raise of awareness about the responsibility for the value chain was brought only recently to a general attention by all the actors.

Coping

Coping mechanisms mainly regard the implementation of contractual agreements, in which a farmer and a seller to buy a certain number of heads at a pre-negotiated price, independently on the market price fluctuations. This strategy is already implemented, it is more and more encouraged by labour unions and was rendered mandatory by a decree of the Ministry of Agriculture and Economics in December 2019 for “label rouge” cattle (also with the aim of increasing label subscriptions). Other coping mechanisms by farmers regard the investment in direct selling and in short local value chain. However, if this strategy can hold in certain cases, it cannot be extended to the whole farming system.

Response

It is already recognized that the strategy to respond to the challenge lies in the re-organization of the value chain. The risk management workshop clearly highlighted that a coordinated action by all the actors of the value chain is needed to transform the structure of the value chain itself. This appears to be the main solution suggested to increase the revenue of the farmers of the Bourbonnais, however its concrete application is only at its beginning. In January 2020, the FNB (*Fédération Nationale Bovin* – the French national federation of cattle production) called for an urgent organisation of an inter-professional plan of value chain centered around an association of producers' organization. The value chain plan would be aimed at improving the dialogue among actors of the value chain and fixing the elements of unbalance in its structure. The association of producers would serve to decrease the concurrence among farmers. Cooperatives would play a key role in facilitating these strategies.

The recent COVID-19 crisis served to put in light the problems of the value chain to a wider range of actors and policy-makers at the country level. The price paid to farmers decreased even with an increased demand for chopped beef by consumers and a lowered concurrence by foreign imports. This led to a protest by a number of farmers that wanted to keep their cattle on farms (even if engaging in extra costs) instead of selling them at a price that did not allow to cover the costs. The protest started from the Bourbonnais and even though the COVID-19 dynamics accelerated the process, it was probably conceived previously, independently from the COVID-19 crisis. The movement echoed at higher level and was endorsed by a number of organisations (FNSEA, FNB, Confédération Paysanne) that recommended to beef farmers in France to keep cattle in their farms in case the price is not fair. In May an official press statement was released by the French Ministry of the Agriculture. The statement highlighted the key role of farmers and the actors of the beef value chain that were able to provide high-quality food to the consumers during the COVID-19 lockdown, and then called to a collective raise of awareness about the unfair low remuneration of beef farmers and about the need to improve the structure of the value chain. The statement also highlighted that the intervention of public policy would not be useful if actors of the value chain would not contribute to a transformation of the value chain itself. The Ministry asked to INTERBEV to provide various data in order to study more concrete strategies of interventions.

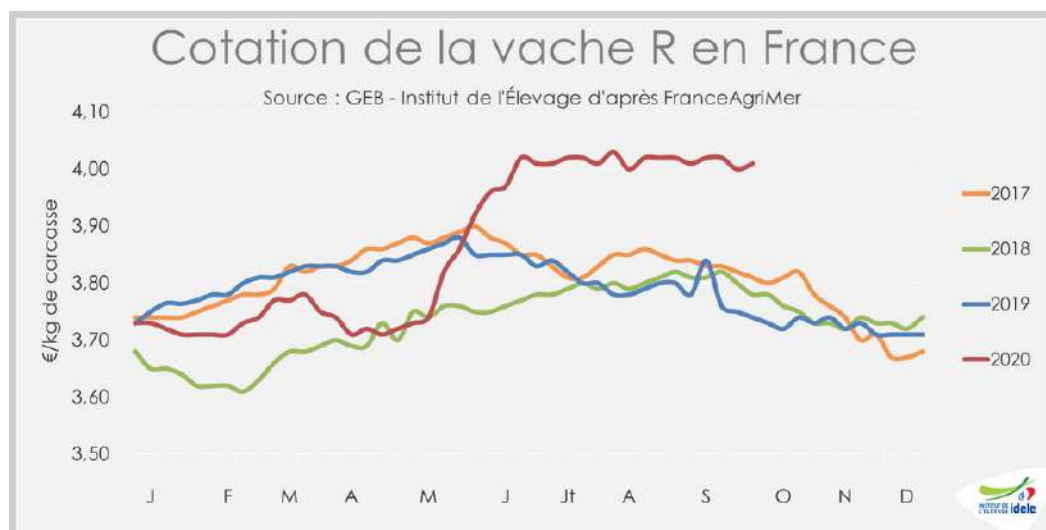


Figure 1: Time evolution of beef prices for female cows in France

In September and October 2020 the price of female cows for internal French market began to increase, in clear contrast with the trajectories observed in previous years (see Figure 1). It is however to be further investigated if this fact was caused by the actions taken during the lockdown or by other dynamics more related to consumers' behaviour. According to an interview of the president of FNB published in September 2020, after the press statement of the Ministry, some bi-lateral agreements were done within the value chain and the price increase obtained in August is a good result (4 euros/kg) served to bring some relief to farmers, but still is not enough to cover the production costs (4.89 euros/kg). The Ministry and other associations are still trying to understand the mechanisms in the value chain that bring to a price deterioration in order to fix them.

In this context, it seems that the resilience-enabling environment is formed by the actors of the value chain but, on a larger level by a set of organizations that amplified the voice of the farmers, raising awareness at a higher level. The intervention of the government as well as INTERBEV and FNB are needed to put pressure on actors of the value chain and to question its structure from a higher level.

The same dynamics is happening also for the transport to Italy. In October, farmers of the Bourbonnais started keeping on farms weanlings for export to Italy, if prices do not increase. This might trigger another investigation of the value chain involved in the export market; however, things will be more complicated as they will involve a value chain in two countries.

3.4 Response to the demographic challenge

Potential impact

It is difficult to disentangle this challenge from the others, as this challenge is mainly an effect of the others. The potential effects of these challenge could be the same of the low farmers revenues. The depopulation of the region would lead to a general reduced rural vitality and of a abandonment of the land. This would result in a degraded landscape where hedges are not maintained and grasslands will be invaded by bushes and forest.

Anticipation

Although this trend was expected because of the increasing ageing of the farmer's population, no particular actions were taken in order to prevent this phenomenon. Most actions were taken for facing more urgent problems and for improving the conditions of farmers during their exercise, prioritizing the shorter-term challenges for individual farmers rather than longer-term challenges for the whole regions. However, the climax of this challenge is probably still to arrive and the strategies proposed during the SURE-Farm activities (mostly the FoPIA-SURE-Farm 1 and the Risk management workshop) could be considered as forms of anticipation for the future

Coping

Some coping strategies are related to the improvement of the quality of life at work (in order to make the farming activity more attractive) and to reduce debts, especially when new farmers start their activity or existing farmers make big investments. We consider these as coping strategies because they do not imply a big change in the structure of the farming system, but mostly an improved role of certain actors. The improvement of the quality of life at work consists of improving the comfort in using technological tools, reducing working hours and enhancing the possibility of taking days or weekends off. The risk management workshop revealed that farm advisors are close to farmers' problem and are good actors for providing solutions. Some insurance schemes provide also some replacement services in case the farmers need or want to go far from the farm for some days. Banks, insurance schemes, and cooperatives have also been highlighted to have the important role of monitoring the situations of the farmers, in order to highlight and prevent some potential problems. The actors mostly involved in the reduction of debts are the banks and cooperatives. In particular cooperatives were mentioned to be useful in providing financial help in cases in which banks refused to do so. In general, the risk management workshop highlighted a very weak role of a number of actors to facilitate the installation of new farmers by reducing debts: accountants are advocated to do a better job in helping farmers in the long-term planning; policy-makers were advocated to commit to a better tax policy, and banks could play a role in funding some projects at the farming system level.

Responding

In order to respond to the demographic challenge, new labour should be attracted to the region. During the FoPIA-SURE-Farm workshop, participants mentioned the need to “professionalize the workforce”. At moment something is being done by some producers or interprofessional associations, that promote at some extent the transmission of skills to potential future farmers. Moreover, farmers should be put in condition to hire skilled labour, but this is being quite difficult in the Bourbonnais and this difficulty was mentioned as a challenge. Other than that, no particular response strategies were mentioned in the previous SURE-Farm activities, nor other information are at our knowledge. However, being the challenge not at its climax, it is still difficult to make an assessment about the responses and the effectiveness of responses. Different scenarios are possible: energies will be focused at maintaining the same number of farms or in the value chains will need to be adjusted as a consequence of the reduced beef production.

3.5 Response to the COVID-19 crisis

Potential impact

The COVID-19 crisis was mostly centred on avoiding contacts between people. If farmers can easily maintain distance between workers on the farm, it is not necessarily the case in other parts of the value chain (e.g., contact with purchasers, transport to Italy). The lockdown measures caused a closure of the restaurants, lowering drastically the demand. The potential impact could have been the paralysis of the value chain, with a huge number of cattle heads blocked on farm.

Anticipation

The shock was not anticipated, even if signals were evident. The French government could see the effects of COVID-19 first in China and then in Italy (the Italian outbreak was 2-3 weeks before the French outbreak and more or less the same time lag was observed between the Italian and the French lockdown). However, no significative preventive measures were taken. Most of the activities in France, including the Bourbonnais beef value chain, started to cope with and to respond to the COVID-19 crisis when it manifested its effects in France.

Coping

The potential impact did not occur in total for the value chain involving the Bourbonnais farming system. The activity of farmers was hit by relatively minor impacts, comparing to other activities. The first two weeks of the crisis were characterized by some panic and some disorganisation. In those weeks some parts of the value chain stopped working and many weanlings and cows

destinated to Italy or to the slaughterhouses were kept on farm. After the first two weeks, the activities of transport and transformation in the value chain could be re-established as it was possible to respect the barrier gestures along the chain. However, one of the biggest problems was the complete stop of the restaurant consumption. This caused a different usage of the animal carcasses: the most “noble” parts (the most rentable, consumed mostly in the restaurants) could not be consumed and the great majority was conveyed to chopped meat. Many heads of cattle were kept on the farm, causing a worsening of the quality of meat. From the EU and the national policy making, two measures helped to cope with the COVID-19 challenge: there was a derogation on the maximum time allowed as well as financial aids to store frozen beef (EU) and there were financial aids, in the form of daily allowance, for the farmers that could not go on the farm (because of positive COVID-19 test, isolation, or care-taking duties). The INAO accepted to modify the requirements for the obtention of “Label Rouge”, so that the production under label could continue. Changes mostly regarded to maximum time cattle could be kept on the farm.

Responding

In general, changes in the system were observed in the way some actors of the system tried to influence the behaviour of the consumer. Some campaigns were done (INTERBEV) in order to promote the consumption, the excess beef produced in some periods of the COVID-19 crisis, for example, a campaign was about the “Pentecost veal”.

Concerning other response systems, no significative changes were observed in the short term, however two interesting mechanisms are worth mentioning. These mechanisms are inter-related with other challenges and have the potential to bring desired outcomes in the next years. First, the COVID-19 seems to have manifested the problems of the structure of the value chain. In the first phases of the French lockdown, there was an increased demand for hamburger and chopped meat to eat at domicile, and in the following phases an increased demand of also other parts of the carcass. The imported beef meat drastically decreased, so the French beef market had no concurrence. Despite all of this, the price paid to farmers was extremely low. This problem was already present before COVID-19 crisis, however the crisis brought to attention that the possible cause of this was in the structure and in the dynamics of the value chain. What happened is described in the response to the challenge of the unbalanced value chain.

Second, there seem to be a raised awareness about the importance of farmers in providing food to the population, alleviating the challenge “social distrust”. In two press statements, the Ministry of Agriculture expressed feelings of thankfulness for the work of the French farmers that assured high-quality food to the dishes of French consumers; one message was explicitly referred to beef cattle farmers. There seem to be an increased awareness of the importance of the activity of

farmers and of promoting local food self-sufficiency. According to recent trends, French people express more and more preference for French beef, especially the one coming from short value chains. As a result of events triggered by these two described mentioned, the prices of beef in 2020 are significantly higher than the past years.

The COVID-19 crisis created problems to all the economic sector and difficulties were encountered in the Bourbonnais, but served as a trigger for raising awareness about challenges of the Bourbonnais system to higher levels of the enabling environment.

4 PATTERN ANALYSIS

Three archetypes were identified in which the resilience-enabling environment plays an important role. In general, the analysis suggests that farmers alone are not able to implement the virtuous solutions that go beyond the “fix-that-fail”, the “addiction” or the “pressure to lower goal”. This does not mean that farmers do not provide solutions or cannot contribute to enhance the resilience of the system. On the contrary, they directly cope with the challenge; in a case, they even triggered actions taken by actors at higher levels. However, some challenges need actions from other actors and require fixes and solutions at higher levels. Three archetypes were identified for interpreting the response of the farming system to the increased drought frequency, the social distrust of agricultural practices, and the lowering of prices. No archetypes were identified for the demographic challenge and for the COVID-19. Concerning the demographic challenge, the climax will probably arrive in the next year and the system is in the phase of anticipation. Concerning the COVID-19, the challenge is still ongoing and although no archetypes were identified, it is important to point out the way it interacted with other challenges and with the resilience-enabling environment.

Archetype of the response of the farming system to increased drought frequency

The response of the Bourbonnais farming system to droughts can be interpreted as an archetype of “addiction” (see Figure 2). Provided that the problem symptom is the decreased availability of feed for cattle (i.e., the reduced grassland primary productivity induced by droughts), the observed solution is a change in the landscape, consisting of an increased area of cereals and temporary grasslands gaining surface over permanent grassland and hampering the maintenance of hedges. This is also accompanied by increased purchase of feed from providers external to the farming system. This might be considered an undesirable solution for three reasons: (1) this new

configuration of the farming system exposes farmers to increased costs (insurance schemes for crops, feed purchase, synthetic fertilizers); (2) the quality of landscape is, at many levels (from farmers to national policy), considered as something valuable and being part of the cultural heritage of the region; (3) hedges actually play a number of landscape services useful for enhancing the resilience of the system, such as protecting soils from erosions, timber production, refuge for biodiversity, windbreak. The presence of many strategies aimed at landscape conservation demonstrate that the landscape is considered part of the resilience-enabling environment of the Bourbonnais.

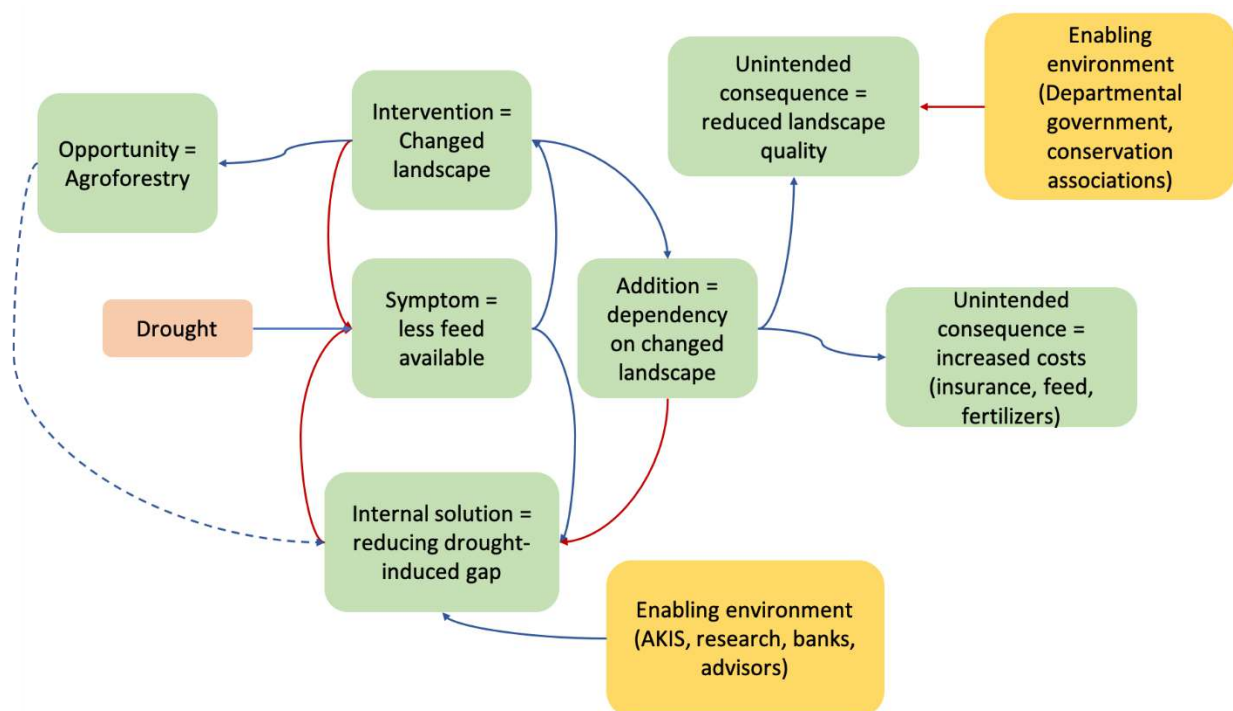


Figure 2 – Scheme of the response of the farming system to droughts and role of the enabling environment. Orange boxes indicate problems and symptoms, green boxes indicate responses at the level of farming system, yellow boxes indicate actions from the enabling environment. The dashed arrow indicates that the link is not yet fully implemented, but has the potential to have an effect.

The internal solution for breaking the addition would be to render the system more drought-tolerant. This would imply investments in research for improved practices and technologies, maybe researching different cattle breeds. In this sense an opportunity is given by one of the consequences of the “addition”: some changes in the landscape are constituted by the increase in agroforestry practices, which have the potential to reduce the drought-induced production gaps. However, this practice is not widely applied in the Bourbonnais and constitutes only a

strategy applied from a minority of challenges, even though it is becoming more widespread. This is why it is represented with a dashed arrow in Figure 2.

The action of the resilience-enabling environment is mostly aimed at contrasting the advancement of crops over grassland and maintaining the landscape. To say this in the language of archetypes (Figure 2), these actions are aimed at contrasting the consequences of the “addition”. The policies of grassland “sanctuarization” alone might not be effective if left totally to farmers. In the Bourbonnais, the department of Allier supports the action of local conservation associations (e.g., “Mission Haies Bourbonnais”). The action of these two actor categories help maintaining the system coupled with the natural capital. Another action in this direction from the enabling environment comes from a decree of the Ministry of Agriculture and the Ministry of Economics (December 2019) that imposed the contractualization with Label Rouge beef farmers in the value chain, in order to help farmers financially to promote practices the preserve the landscape.

Archetype of the response of the farming system to social distrusts

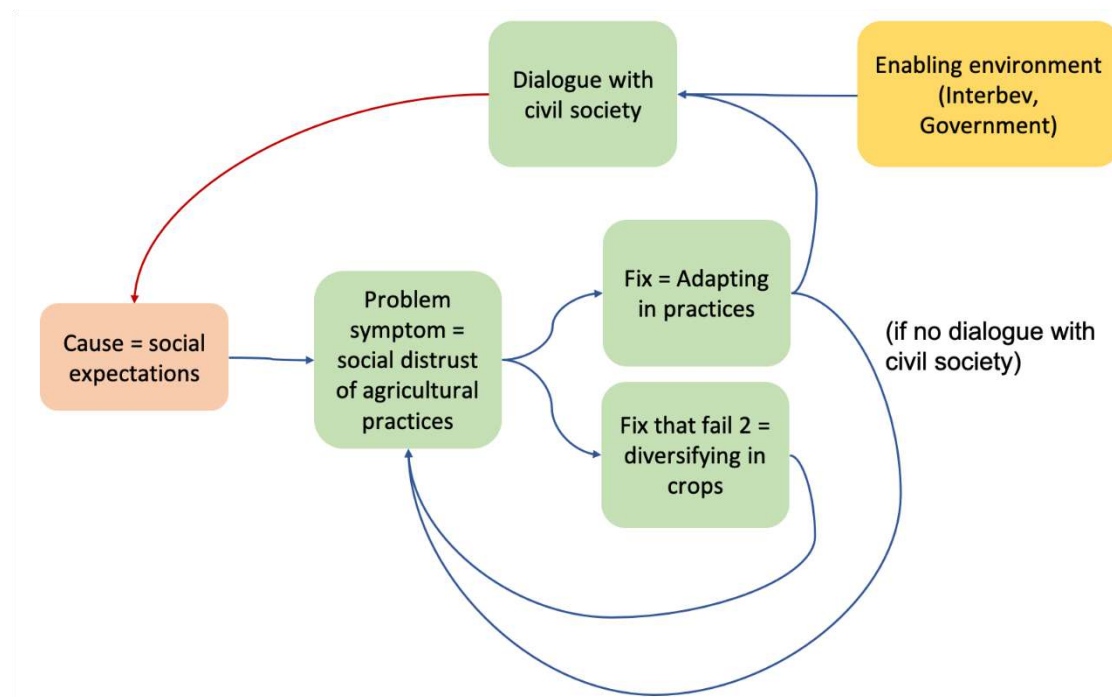


Figure 3– Scheme of the response of the farming system to increased social distrust and role of the enabling environment. Orange boxes indicate problems and symptoms, green boxes indicate responses at the level of farming system, yellow boxes indicate actions from the enabling environment.

The dynamics related to the response of the farming system to increased social expectations and to the public distrusts can be considered as a “fix-that-fail” archetype (Figure 3). The response to the challenge has as fixes the diversifications in crops and the adaptation of the practices to meet the social expectations. The diversification in crops serves to open new market avenues without really addressing the problem. The adaptation of practices is in theory a good solution, however there is no effect if there is no adequate communication with consumers. The real fix that seem to be effective comes from the facilitation of the dialogue with the civil society. Farmers alone can achieve this purpose only at the local level and with short value chain: the recent increase in direct selling in the Bourbonnais is a good signal; however, farmers cannot alone reach a wider audience at the national scale. For constructing a good and solid dialogue at the national scale, the intervention of actors at higher levels is necessary, with also the contribution of trade union organizations. In the Bourbonnais, INTERBEV promoted a number of initiatives, such as the “Pacte d’engagement societal” and the sensibilisation to flexitarianism (in order to face the delicate debate with vegans).

Archetype of the response of the farming system to the unbalanced value chain

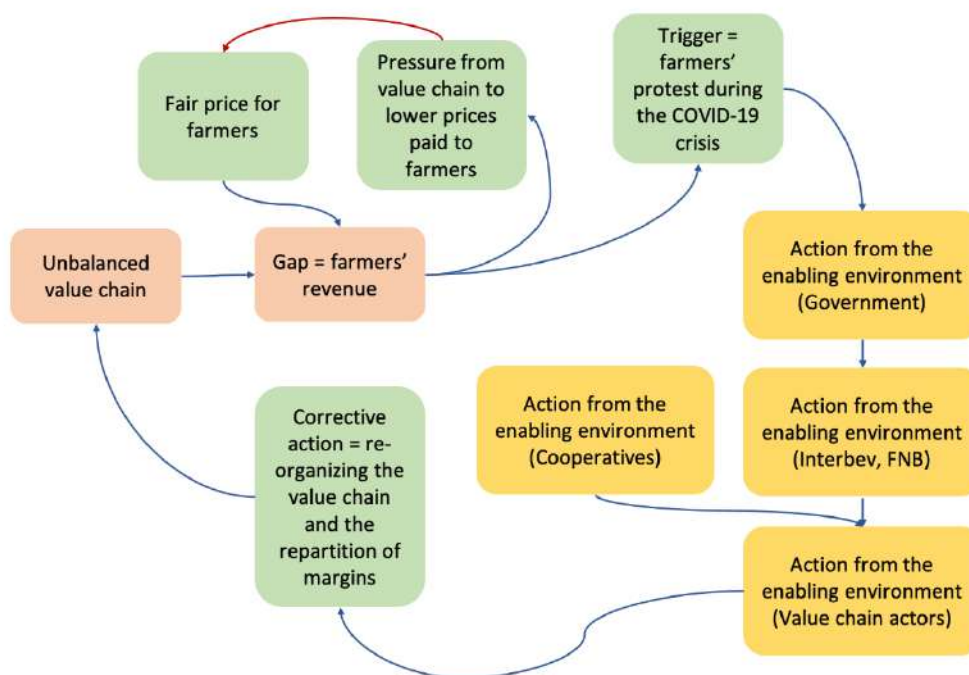


Figure 4 – Scheme of the response of the farming system to the low revenues of farmers and to the unbalanced structure of the value chain. Orange boxes indicate problems and symptoms, green boxes indicate responses at the level of farming system, yellow boxes indicate actions from the enabling environment.

The dynamics related to the problem of the unbalanced value chain reveals that farmers were in a “boiling frog” (“shifting the goal”) trap (Figure 4). Farmers were a weak part of the value chain captured in a mechanism of decreasing prices. This mechanism was kept into life because probably of inertial mechanisms and the gradually decreasing transparency of the mechanisms of the value chain that reduced the bargaining power of farmers with downstream actors of the value chain. The corrective action to this problem would consist in fixing the structure of the value chain. Very recently, in the context of the COVID-19 crisis, this happened with the following dynamics. Protests by farmers gained more and more visibility, amplified by other actors (e.g., INTERBEV, FNB, confederation des paysans). This triggered the intervention of the Ministry of Agriculture that took action calling for a raise of awareness about the low farmers revenue and the asked for action within the value chain via diagnosis and fix of the value chain structure. INTERBEV and FNB accelerated the conception of multiple bilateral agreements between farmers and other value chain actors and conceived a “value chain plan” as well as an association between farmers, in order to reduce their concurrency. In building such an association, the role of cooperative was important in mediating. For this challenge, it is important to note that farmers need the intervention of other actors of the farming system for solving the problems in the value chain, however they could act as a trigger as everything started from their protest. It is also to be noted that, because a major event for the beef value chain was cancelled (“Sommet de l’élevage”), the minister visited personally the Bourbonnais, reducing the distance between farmers and policy. The enabling environment acted in different ways: by amplifying the voice of farmers (interprofessional organization, FNB, confederation des paysans); by acting as “referee” in the value chain (Ministry of Agriculture and interprofessional organization); by mediating between farmers and other farmers or other value chain actors (cooperatives); by collaborating in the agreements (value chain actors).

Interaction between the COVID-19 crisis and other challenges

The shock of the COVID-19 crisis put surely the system under stress, with a general need of adaptation to the barrier gestures in the whole value chain and with a stop of the restaurant consumption. However, it is important to note how this challenge interacted with the economic challenge (low profitability due to the unbalanced value chain) and with the social distrust. The COVID-19 crisis rendered manifested the problems of the value chain in which the Bourbonnais farming system was embedded. Although, according to press releases, farmers had already the idea of protesting before (not selling their cows at low prices) before, the COVID-19 crisis accelerated this process. In addition to this, the COVID-19 crisis seems to have increased the feelings of gratitude of the civil society to all the French agricultural sectors in general, and to the farmers of the Bourbonnais in particular., providing some relief to the challenge related to the social distrusts of farming practices.

Enabling environment: actors, resources invested, resilience attributes and capacities enhanced

Table 2 provides a summary of the characteristics of the resilience-enabling environment and how it takes form in the context of different challenges in terms of actors, actions performed, types of resources invested, resilience attributes and capacities enhanced.

Table 2 – Summary of actors having a role in the resilience-enabling environment of the Bourbonnais, along with resources invested, resilience attributes and capacities enhanced

Challenge	Actor	Action	Type of resources invested	Resilience attribute enhanced	Resilience capacity enhanced
Increasing frequency of droughts	Insurance companies	Subscription of insurance schemes	monetary	Reasonably profitable, supports rural life	Robustness
	Cooperatives	Facilitate exchange among farmers	social	Socially self-organized, infrastructures for innovations, reflective and shared learning, honours legacy, builds human capital	Robustness, adaptability
	Department of Allier	Support the conservation of the landscape, protecting it from the advancement of crop cultivations	monetary, knowledge	Coupled with local and natural capital (production), coupled with local and natural capital (legislation), ecologically self-regulated	Robustness, adaptability
	Conservation associations	Conservation of the landscape, support to farmers	monetary, knowledge, workforce	Coupled with local and natural capital (production), ecologically self-regulated	Robustness, adaptability
	Farmers advisors	Advice on best practices for reducing the drought-induced gap	knowledge	Response diversity, builds human capital	Adaptability

	Research and AKIS	Research on practices for reducing the drought-induced gap	knowledge	Response diversity, builds human capital	Adaptability
	Government (Ministry of agriculture and economy)	(December 2019) Obligation of contractualization with Label Rouge farmers	policy/law	Reasonably profitable, Coupled with local and natural capital (production), coupled with local and natural capital (legislation), supports rural life	Robustness
		Grassland sanctuarization	policy/law	Reasonably profitable, Coupled with local and natural capital (production), coupled with local and natural capital (legislation)	Robustness
Social distrusts	Advisors	Advice on best practices for reducing environmental impact and for increasing animal welfare	knowledge	Response diversity, builds human capital	Adaptability
	Research and AKIS	Research on best practices for reducing environmental impact and for increasing animal welfare	knowledge	Response diversity, builds human capital	Adaptability
	Inter-professional associations (Interbev, FBN)	Pacte d'engagement societal (dialogue with the civil society)	communication	Builds human capital, connected with actors outside the farming system	Adaptability
		Communication campaign for flexitarianism	communication	Builds human capital, appropriately connected with actors outside the farming system	

	Local consumers	Valorisation of short and local value chains	monetary	Globally autonomous and locally interdependent	Robustness
	Cooperatives	Promoting knowledge exchange and mutual support	social	Socially self-organized, infrastructures for innovations, reflective and shared learning, honours legacy, builds human capital	Robustness, Adaptability
		Facilitating the producers organization for the value chain plan	social	Socially self-organized, diverse policies, supports rural life	
	Government (regional and national level)	Facilitating access of farmers to the public market	social, policy/law	Reasonably profitable, response diversity, supports rural life, appropriately connected with actors outside the farming system	Adaptability
		Public acknowledgement of the importance of beef farmers during the COVID-19 crisis	communication	Supports rural life, honours legacy	Transformability
	Unbalanced value chain and low prices	Amplification of farmers' voice	communication	Appropriately connected with actors outside the farming system	Transformability
		Diagnosis of value chain problems	knowledge	Reflective and shared learning, supports rural life, builds human capital, infrastructures for innovation	Transformability
		Promotion of mutual agreements between farmers and actors of the value chain	communication	Reasonably profitable, socially self-organized,	Transformability

				reflective and shared learning	
		Value chain plan	organization	Socially self-organized, supports rural life, globally autonomous and locally interdependent, appropriately connected with actors outside the farming system	Transformability
		Producers' organization	organization	Socially self-organized, supports rural life, globally autonomous and locally interdependent, appropriately connected with actors outside the farming system	
	Government (Ministry of agriculture)	Call for a collective raise of awareness about value chain problems	communication	Supports rural life, appropriately connected with actors outside the farming system	Transformability
		Call to action of the inter-professional association for diagnosing the value chain problems	organization	Appropriately connected with actors outside the farming system	Transformability
		Visit to farmers in the Bourbonnais due to cancelled "sommet de l'élevage"	communication	Support rural life, appropriately connected with actors outside the farming system	Transformability
		(December 2019) Obligation of contractualization with Label Rouge farmers	policy/law	Reasonably profitable, Coupled with local and natural capital	Robustness

				(production), coupled with local and natural capital (legislation), supports rural life	
	Value chain actors (for internal French market)	Openness to dialogue	communication	Socially self-organized, infrastructures for innovation, globally autonomous and locally interdependent	Transformability
	Cooperatives	Facilitating the creation of producers' associations	social	Socially self-organized, appropriately connected with actors outside the farming system	Transformability
Demographic challenge	Insurance schemes	Replacement services	monetary, social	Functional diversity, supports rural life, builds human capital	Adaptability
		Monitoring farmers' situations	social	Socially self-organized, supports rural life	Adaptability
	Inter-professional organisation (Interbev, FBN)	Professionalize the workforce	knowledge	Builds human capital, reflective and shared learning	Adaptability
	Cooperatives	Financial help to reduce debts	monetary	Reasonably profitable, supports rural life	Robustness
		Monitoring farmers' situations	social	Socially self-organized, supports rural life	Robustness
	Banks	Funding investments in innovations	monetary	Reasonably profitable, infrastructure for innovation	Robustness
	AKIS	Monitoring the farming system situation	knowledge	Reflective and shared learning, supports rural life, builds human capital,	Robustness

				infrastructures for innovation	
COVID-19	Government (Ministry of Agriculture)	Daily allowance for farmers that could not go on the farm	monetary	Response diversity, diverse policies	Robustness
	Value chain actors	Barrier gestures	behavioral	Response diversity	Robustness
	INAO	Modification of the label rouge protocol to the COVID-19 situation	law/policy	Response diversity, diverse policies, coupled with local and natural capital (legislation)	Robustness
	Inter-professional associations	Promotion of the consumption of beef for consuming the supply surplus ("Pentecost veal")	communication	Functional diversity, appropriately connected with actors outside the farming system.	Robustness
	EU	Increase in the maximum time of beef stockage	Law/policy	Response diversity, diverse policies	Robustness

The increasing frequency of the droughts highlight the importance of the natural capital for the farming system. Efforts are mostly in the direction of maintaining the status quo, i.e., maintaining the system linked on the natural capital, depending on grasslands and hedges. Actions mostly contrast the effects of the adaptation of farmers to the droughts. The main actors having a role in this sense (local policy-makers and conservation associations) support farmers in taking care of the landscape or in supporting farmers to do so. Other actions mostly go in the direction of rendering the system more drought tolerant. The resources mostly invested for the landscape conservation or for making the system more robust to droughts are based mostly on knowledge transmission, workforce, and building social links. Shorter-term actions like insurance schemes are based on monetary resources. The resilience capacity enhanced are mostly robustness (maintenance of the landscape) and adaptability (changing the practices). The resilience attributes mostly enhanced are "coupled with the natural capital" and "ecologically self-regulated" and "support rural life".

For coping with the social distrust, efforts are in the direction of the adaptation of the farming system to societal expectation and at the same time in of the sensibilisation of public opinion. Resources invested are based on communication, knowledge transmission, facilitation of social links and policy adaptation. Resilience enhancing capacity go mostly in the direction of the

adaptation, and the attributes are mostly “builds human capital”, and “appropriately connected with actors outside the farming systems (especially consumers)”. The actors of the enabling environment are at a high level, being them mostly the inter-professional organization Interbev. The local consumers appear to be part of the resilience-enabling environment, as they value the practices of the farmers and direct selling is increasing.

Concerning the unbalanced value chain, the enabling environment is promoting mostly transformability. The main resources mobilized are related to communication, knowledge transmission, and organization (at the level of value chain). The resilience attributes mostly enhanced are “socially self-organized” (communication among farmers and with actors of the value chain), “appropriately connected with actors outside the farming system” and “support rural life”. There is more and more a raise of awareness about the need of fixing the mechanisms in the value chain that make prices lower. This is in line with the outcomes of the risk management focus group, in which participants highlighted the importance of coordinating the whole value chain for promoting a transformation of the value chain.

Concerning the demographic challenges, at moment, no particular transformations are being made. The resilience capacity enhanced are mostly robustness and adaptation in order to improve farmers’ life quality and reducing debts, with the final aim of improving the attractiveness of being a farmer in the Bourbonnais. Actions of the enabling environment are mostly enhancing the attributes “Reasonably profitable” and “support rural life”, while only some actions are invested in “building human capital” by professionalizing the workforce.

For the COVID-19 crisis, actions were taken mostly by the government, EU, Interbev, and the value chain actors with the purpose of rendering the system more robust with the consequence of the virus itself and of the lockdown measures. Most resources invested were monetary, others were related to communication (especially for raising the demand in order to face the delayed supply surplus). Overall there were temporary adaptation of the farming system, aimed at promoting the robustness to the shock.

5 CONCLUSION

With the analysis done, some characteristics emerge about the overall resilience-enabling environment of the farming system.

1. The most transformative actions of the farming system, as well as the actions that go beyond the “fix-that-fail”, the “addiction” or the “pressure to lower goal”, mostly involve communications, building social contacts, and knowledge transfer. These actions are aimed to appropriately connect the Bourbonnais farmers with actors outside the farming

systems (especially consumers, farmers in other farming systems, and value chain actors). Although these actions involve some economic investment, we did not consider them as “monetary resources”. Monetary resources are intended to be direct transfers of money between farmers and other actors. In these sense, monetary resources are invested for insurance schemes, purchase by local consumers, aids for preventing debts. Those are all strategy mostly aimed at increasing the robustness in the short term.

2. From the analysis, it emerges that a number of actions by conservation associations, departmental and country policy-makers are aimed at the conservation of the landscape, trying to keep the system coupled with the natural capital. National policies encourage farmers to produce under certification “Label Rouge” and the INAO modified the rules for obtaining the certification during the COVID-19 crisis, so to guarantee that production respect environmental standards also during the crisis. The Department of Allier is also pro-active in landscape preservation supporting local associations. These actions of landscape protection imply that the landscape quality is considered as part of the resilience-enabling environment. However, the burden of landscape preservation cannot be left entirely to farmers and support of associations, and policy makers (mostly at the Departmental level) is needed.
3. Local short value chains can be seen as part of the resilience-enabling environment as they constitute a good market-diversification avenue. Local consumers seem to value the production of beef coupled with the landscape. However, the production of the Bourbonnais is massive and cannot rely entirely on these value chains.
4. Farmers of the Bourbonnais do not have the possibility to reach consumers and gain bargaining power in the value chain. The enabling environment in this case is composed by higher-level actors (inter-professional organizations, policy-makers from Department to France level) that facilitate the dialogue with the civil society and with the actors of the value chain.
5. Cooperatives seem to be an essential component of the resilience-enabling environment in the Bourbonnais. Interviews done in the context of SURE-Farm already highlighted the very strong attitude of the Bourbonnais farmers to associate. Cooperative act in many ways: providing financial help, facilitating the exchange of information, promoting dialogues with actors in the value chain.
6. Value chain actors could potentially be part of the resilience-enabling environment, but at moment they mostly appear to be resilience-constrainers. Actors at higher level (inter-professional organizations, Ministry of Agriculture) are actually acting as referees and problem solvers for the value chain. Hopefully, improvement in the value chain should turn it from resilience-constrainer to resilience-enabler.

Still there are open challenges for the Bourbonnais system, in which the resilience-enabling environment could play a role.

1. The value chain of the export market (male weanlings exported to Italy) also needs some fixes. The dynamics seems to start (in these months) as it started for the female cattle for French consumption, with farmers that keep or are encouraged to keep weanlings on farm. Here the fix of the value chain appears to be more complex as it would involve actors in two countries.
2. Making the system more drought-resistant appears to be difficult, without a change in the landscape. Here the role of research should be prominent, however, the risk management focus group highlighted that research is actually far from problems of the farmers.
3. The demographic challenge will probably get its climax in the next years. The Bourbonnais system is part of a set of departments in the Massif central (centre of France) that produce much more than the internal French demand. Either the number of farms will be maintained, or some transformations will occur in the value chains. In any case, transformations are likely to occur and a resilience-enabling environment needs to be involved for dealing with these transformations.



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1 FARMING SYSTEM AND ENABLING ENVIRONMENT ACTORS AND INSTITUTIONS

Italy is the world second-largest producer of *Corylus avellana*, i.e. hazelnut, after Turkey. Our farming system (FS) is located in the largest production area of Italy, the province of Viterbo of the region Lazio in central Italy. Viterbo province is the first one in the country in terms of volume of production with, according to the National Statistics Institute (ISTAT website), 46,200 tons in 2018.

The hazelnut cultivation in the area has a long story and now it covers around 21,000 ha and is performed by more than 6,000 farms. The core area of hazelnut cultivation is represented by the Cimini Mountains that surround the Vico volcanic lake. This area is characterized by a strong vocation for such products because of the nature of the soil. The main cultivar is the “Tonda Gentile Romana”, registered under the PDO (Protected Denomination of Origin) scheme (Rugini and Cristofori, 2010), and the average product quality is relatively high and suitable for further processing by the downstream confectionary industry.

Hazelnut production is a major economic resource in Viterbo province, and it is a traditional activity: the area does not offer favourable conditions for farming; therefore, hazelnut cultivation provides satisfactory levels of income to farmers. In recent years, the increased market demand for hazelnut and the reduced profitability of other crops have led to an expansion of the cultivated area and hazelnut farming is expanding in surrounding areas traditionally unrelated to this cultivation (Nera et al., 2020). In many municipalities, hazelnut uses a very large share of the utilized agricultural area becoming basically a monoculture. Furthermore, the hazelnut has witnessed a strong modernisation of the cultivation, with growing levels of specialization and mechanization.

Raw unshelled hazelnuts are channelled through an articulated network of intermediaries. Most of the production is channelled through half a dozen Producer’ Organizations (PO). These have a relevant role in terms of supply concentration and storage, but in general, do not process further the production. Only a few of these unshell the fruits and even less process hazelnut locally obtaining semi-finished products (e.g. hazelnut past) or selling to retailers. Indeed, a very large share of the production is sold by POs to the downstream confectionary industries that are dominated by few and very large companies such as Ferrero, and Loacker, among others. These are not located in the area and operate on the international market of raw (shelled) hazelnut. Turkey that ensures a large share of the world production dominates this market. This is why the production conditions and policy decisions of Turkey may cause relevant oscillations of hazelnut international prices. However, the production of hazelnut in other countries is increasing also because the confectionary industries follow a diversification strategy of the suppliers.

The FS is composed of actors belonging to the enterprise, government, AKIS, and social domains (Table 1). The main actors of the FS are the farms and the households managing these, as well as the local downstream operators such as OPs and local processors. The enabling environment surrounding our FD includes actors who influence the FS but who are themselves scarcely influenced by the system. Among these, there are local public administration, machinery providers, confectionary industry, research and development, professional associations, input providers. Other actors indirectly influence the FS such as retailers, the European Union, national and regional public administration, NGOs. The CAP plays a role in the development of the FS. The most influential policies are the Common Market Organization (CMO) measures and the Rural Development Policies. In contrast, negligible is the role of direct payments because these represent a relatively less important source of revenues for such high revenue crop. The support of CMO is channelled through POs that play a very important role in supporting farm investments, technical advice and supply concentration. Support from RDP policies comes from several measures supporting farm investments and the use of environmental-friendly practices as well as the Leader Program. The latter is operated by a Local Action Group that has been active in the FS area since 2007.

The enabling environment also includes credit and insurance institutes that provide tools to protect against risks. A key important role also covers any kind of research activity and training support to the FS due to the technical vision of farming. The main actors involved in this process belong to the AKIS domain (Agriculture, Knowledge and Innovation Systems) such as POs, research institutions (as the local University) and agronomists. Not less important is the role played by the actors of the societal domain such as the BioDistrict and Local Action Group. Specifically, BioDistrict is a functional geographical area, in which an alliance is established between farmers, citizens, tour operators, associations and public administrations, for the sustainable management of resources, based on the organic model of production and consumption. Here, the promotion of organic products is combined with the promotion of the territory and its peculiarities, in order to foster a full development of its economic, social and cultural potential.

Table 1: Actors in the Italian hazelnut farming system and its enabling environment.

Actors	Formal institutions	Informal institutions
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Enterprise domain: Farming system actors: <ul style="list-style-type: none"> – PO («Assofrutti», «Coopernocchie») and cooperatives – Local processor «BioNocchie» – Farms – Farm households Other actors: Confectionary industry («Ferrero Commerciale Italia s.r.l» and «A. Loacker s.p.a») <ul style="list-style-type: none"> – Input supplier (machinery): «Facma», «G.F Costruzioni macchine agricole» 	Producers' organizations, Cooperatives, Processing industry	Attitude towards cooperation
Government domain: European Union Italian government - Ministry of Agricultural, Food and Forestry Policy Common Market Organization (CMO) Regione Lazio (Rural Development Program-RDP) Province of Viterbo (water and environmental issues) Chamber of Commerce Municipalities (public health safety)	Agricultural policies including CAP, Food, environmental and human health safety laws PDO and other marks management and certification	Accountability Farmer participation
Intermediary domain: Banks, Credit Institutions, Insurances	Consulting, credit	Protection against risks, save money
AKIS domain: PO, University of Tuscia (Viterbo), ARSIAL (Regional Agency for Research and Development), agronomists/advisory staff	Research, consulting	Technical vision on farming, information' flow
Societal domain: BioDistrict of the <i>Via Amerina</i> and <i>Forre</i> ", local and environmental NGOs such as WWF and Slow Food. Hazelnut fairs and festivals organizers, " <i>Pro loco</i> ", Local Action Group.		Societal and ecological vision on farming,

2 CHALLENGES AND ADVERSE EVENTS IN THE LAST 10 YEARS

The farming system faces the following challenges:

1. Reduction in the profitability of other crops (TREND)
2. Extreme weather events: drought and heatwaves (NOISE/TREND)
3. *Phytopathologies - Asian bug infestation* (NOISE)
4. Concentration of the confectionary industry (TREND)
5. Growing societal demand for eco-friendly practices (TREND)

Reduction in the profitability of other crops (TREND)

In the last decade, the prices of several agricultural products such as cereals, standard quality wine, sheep and cow milk have decreased. This has caused a reduction of the profitability of these crops making hazelnut to become one of the most profitable crops in the area. This, together with the positive trend of hazelnut prices has encouraged the expansion of cultivations beyond the traditional area of cultivation, i.e. around the Vico Lake and the Cimini hills. Since the reduction in the profitability of alternative crops has been going on for years this can be classified as a trend.

Extreme weather events: drought and heatwaves (TREND)

Due to climate change, extreme events have recently increased in intensity and frequency. This has negative impacts on agricultural production and, to a lower extent, on the viability of the FS. In the future, drought could increasingly be a challenge for agriculture. The new climate scenarios show a slight decrease in cumulative precipitation in late spring and summer and, more markedly, an increase in the length of drought periods. This is accompanied also by heatwaves in the summer. These events can affect the production quantity and quality especially in the non-traditional areas of production that are located at a lower altitude, where precipitations are lower and soil conditions are less favourable. A larger quantity of surface depends now on irrigation: all new plantations are equipped with localized irrigation systems. This is leading to growing pressure on water resources: larger irrigation volumes will be necessary as well as longer irrigation seasons.

Extreme weather conditions are becoming more frequent than in the past. Hence, it is possible to define it as a trend and it is usually not possible to predict when it will occur. This generates a relevant production risk for farmers (Zinnanti et al., 2019).

Phytopathologies - Asian bug infestation (NOISE)

Several *phytopathologies*, affect hazelnut production. Among these, one important pest is due to bugs (gen. *Halyomorpha*) causing damages to yields and to fruits quality. This has negative economic consequences on farm profitability. Bugs are potentially dangerous because they carry out the life cycle in the nut, damaging the fruit that will suffer a qualitative depreciation. Phytopathologies were discussed in terms of the percentage of hazelnuts damaged by bugs. In the past, this has been seen as noise. While some years are worse than others, it is generally possible to control this bug using chemical treatments.

However, the situation is changing. There is a serious risk that the Asian type of bug (*Halyomorpha halys*) will spread also in the area in the coming years as it is the case in the north of Italy where this bug is causing relevant damages and required more frequent chemical treatments. To date, it has only been spotted a few times in the area of the Viterbo FS, but farmers are worried about

it. The same can be said of environmental groups that fear the farmers will react by increasing the use of the chemical to control this bug.

Concentration of the confectionary industry (TREND)

This challenge concerns the fact that there are a few large multinational companies in the downstream confectionary industry buying raw hazelnuts. Some of these have been reported to have not negligible market power (Liberti, 2019). These are confectionary industries operating in the international market and currently located in the northern part of the country (e.g. Ferrero Commerciale Italia s.r.l. and A. Loacker s.p.a). Their strategic decisions, especially in terms of procurement of raw hazelnuts, can have relevant implications for the FS. The confectionary industry influences prices and imposes production protocols affecting production practices and costs. In particular, they are increasing the quality standards required to buy raw hazelnuts and differentiate the price paid to farmers according to quality parameters. This provides a strong incentive for farmers to adopt practices that increase the quality of the product and decrease its variation over time. This is done by using both irrigation and chemical treatments against insects. This has been claimed to have potential negative effects on the environment and human health (Reidsma et al., 2020).

Growing societal demand for eco-friendly practices (TREND)

The specialization trend of hazelnut cultivation, together with the use for chemical treatments, is growing a climate of hostility in public opinion against the expansion of hazelnut cultivation that is going in the area. This hostility comes from groups of environmentalists, organized locally but included in a larger network of environmental groups. The problem is also acknowledged by some municipalities that are experiencing a rapid expansion of the cultivation. This has caused a growing debate regarding the opportunity to limit this expansion and to control farming practices potentially harmful to the environment and human health. The emphasis placed by society on these issues is becoming a challenge for the FS. Some municipalities have asked for a stop to new plantations and have introduced restrictions on the use of irrigation and chemicals. Examples are restrictions on the use of chemicals when fields are close to residential areas. This may undermine the farmer's reputation as well as the whole system connected with hazelnuts cultivation. As stated by stakeholders of the FS, the adoption of more eco-friendly practices is currently hampered by their negative impact on the economic results of farms. More in general, the debate has become in some cases harsh and has even attracted some interest in national media (Liberti, 2019).

3 RESPONSE ANALYSIS

Reduction in the profitability of other crops

As already said, the prices of several agricultural products such as cereals, standard quality wine, sheep and cow milk steadily declined in the last decade. This has caused a reduction in the profitability of other crops pushing hazelnut to become one of the most profitable crops in the area.

This, together with the positive trend of hazelnut prices in a price volatility framework, is encouraging the expansion of this crop also outside the traditional and more profitable area of cultivation, i.e. around the Lake of Vico and Cimini mountains. This is pushing toward an increase in the production specialization in the area: in many municipalities of the area, hazelnut covers more than 2/3 of the whole Utilized Agricultural Area. This has consequences in terms of the characteristics of the landscape and intensification of the farm activity. Environmental groups claim this has negative implications for the environment (including biodiversity of habitats, genes and species) and human health. Because of the nature of the phenomenon, which can be classified as a trend, this has been anticipated by farmers as well as other investors. This reinforces the incentive for developing new hazelnut plantations.

The phenomenon is negatively affecting farm economic results. Farmers cope with this by reducing their investments and consumption levels as well as working more off-farm. The main response has been shifting to hazelnut when the conditions are suitable for doing so. This requires relatively large investments including new plantations, wells and irrigation equipment. Only after around 7 years after plantation farmers buy dedicated harvesting machinery i.e. after the new plantations begin to produce. New established hazelnut farms do often shift to organic farming. This allows benefiting from the support provided by RDP measure supporting organic farming that amounts to around 800 Euro/ha per year. The limit to production practices does not directly affect farm revenues just because there is no production. Indeed, after around 5 years (in which farmers are obliged to remain organic) farmers can shift back to conventional production systems. This strategy can improve the profitability of the investment also in areas not very suitable for growing hazelnut.

Extreme weather events: drought and heatwaves

Extreme weather events, drought and heatwaves, are becoming more frequent and severe. This is posing a growing pressure on producers because these events have a severe effect on both production levels and quality. This hampers the variability of the economic results of their farms. Farmers respond by systematically using irrigation systems and increasing irrigation volumes

when needed. This is bringing growing pressure on the groundwater stock. Hence, this is seen as negatively affecting the maintenance of natural resources in good condition.

The increasing frequency and severity of these events have been anticipated by farmers to some extent. Now almost all new plantations are established with irrigation equipment. In contrast, it seems that the effect of heatwaves is not always anticipated by all investors. In the untraditional areas of production, heat waves are more frequent and severely affecting the economic results.

Traditionally, the effects of such extreme weather events have been copied by maintaining adequate financial resources to be used during harsh times. According to the analyses developed during the project, there is an interest in other risk management tools such as insurance schemes. These have not been developed so far apart very few attempts. This is also because hazelnut is still produced in a few concentrated areas and no enough data are available regarding the frequency and extent of the losses caused by such events. Hence the traditional strategy remains the most important to cope with extreme weather events.

Response mainly refers to always developing irrigation equipment, especially in the new plantations that are established in the non-traditional areas of production that are more affected by such events. However, this does not solve the problem of heatwaves. Similarly, stakeholders believe that not always new investors respond to these events for example by selecting the most appropriate varieties and the most suitable areas.

Phytopathologies - Asian bug infestation

Several biotic factors affect both production level and quality. One of the most relevant pests is the bed bug. Considering the current average level of 10% of hazelnuts damaged by bugs, increasing the percentage level of bug's infestation, the FS could decline. This seems very likely if the Asian bug (*Halyomorpha halys*) will spread in the area. Under this circumstance, farmers are expected to more extensively use chemical control. This could have negative consequences on the environment, especially water quality, and on the health of the population living in the area.

While the current set of easily anticipated by farmers, this is not the case of the Asian bug. There are different opinions regarding the probability to have relevant infestations of this bug. Hence, farmers cannot easily anticipate this challenge.

The large majority of farmers cope with the phytopathologies by using chemical treatments. This is done in different ways and using different protocols. Response

The use of integrated pest management is spreading. In contrast, organic practices to control phytopathologies are generally seen as not effective coping strategies. This strongly reduces the interest in switching from conventional to organic farming.

Concentration of the confectionary industry

The confectionery industry represents the main outlet for the local production of raw hazelnut. The strong and longstanding partnerships among the confectionary industries and local post-farm agents (including POs) is a key factor in ensuring farmers always sell their production at reasonable prices. The growth of demand for final confectionery products has generated a growing demand for raw hazelnut, too. This has maintained a positive trend of hazelnut prices. Large companies such as Ferrero are also interested in maintaining good commercial relations with the producers of this area. This is because it ensures a relatively high-quality product. This is also testified by the fact that Ferrero recently acquired a local shelling plant previously owned by a local PO.

This has ensured the economic viability on-farm and contribute to a positive economic territorial development.

However, the situation is changing because of two main factors. First, the confectionery industry is promoting an increase in the areas planted to hazelnut in other Italian regions as well as other countries in the world. This is a strategy mainly aimed at having more products and, even more important, more sellers. This latter is key considering that the confectionery industry is strongly dependent on the supply of raw hazelnut from Turkey. Any problem in that market (coming from climatic or policy conditions) can have relevant consequences on the supply of raw hazelnut on which some companies strongly rely. Second, the confectionery industry is requiring higher product standards, as already said. This strategy is pursued by modulating the paid prices according to quality standards.

The growing area of production is potentially leading to a reduction of hazelnut prices if the demand is not growing enough. While this seems not very likely, farmers are worried about the competition from the new producers, especially those in countries where production costs are lower than in Italy.

Product quality standards can be more easily reached by using irrigation and adequate chemical treatments. Both strategies may have negative consequences on the amount and quality of natural resources in good conditions. Furthermore, the improper use of chemicals can have negative consequences on the health of the local population. The request for the high quality standard is reducing the interest in eco-friendly crop practices as well as organic production as affirmed by the stakeholders in the FS.

The presence of a sure and established selling option for a large amount of raw hazelnut has made it not useful to find a diversified portfolio of buyers. Similarly, this has made it less useful to develop processing activities able to generate the valorization of the product locally. The large majority of POs do not process the raw hazelnut but just stock and unshell these. There are only a couple of small enterprises that process hazelnut locally selling the processed hazelnut (e.g., hazelnut flour, grounded hazelnut and hazelnut paste) to small confectionery industry and (limitedly) to the retail sector.

Because the FS depends on the decisions of the confectionery industry and this buys an extremely significant share of local production, the FS is perceived as vulnerable in case some of these big buyers should change their buying strategy. While this is not very likely, the presence of around 5 different POs and wholesalers increases such risk.

While the problem is felt, anticipation is very limited. Only a few operators are very worried about this trend. Some municipalities where hazelnut has been introduced and is rapidly expanding are considering the possibility that this will have negative consequences on the environment including a change in landscape as well as increasing pressure on water quality and quantity.

The FS is not able to contrast this trend. So far, the FS has adapted to the requests from the confectionery industry. The FS has responded well to the industry's need by means of specialization, intensification and industrialization of the production process. Ensuring the possibility to sell a large amount of raw hazelnut has been pursued by satisfying the need of buyers. Indeed, POs have cooperated with the industry providing technical support to farmers, enhance product quality, and perform the first phase of processing such as shelling and stocking.

The support provided by the CAP Common Market Organization, channelled through the POs has been indeed used to follow this trend. In particular, investments in machinery and infrastructures operated by the POs have been instrumental to the expansion and intensification of the crop and the post-farm activities.

Limited has been the response in terms of diversification of products, services and sales channels as well in terms of valorization of the raw hazelnut locally. Only a couple of downstream operators and one OP are developing small processing activities, so far. Limited is the attempt to have processed products linking them to the geographical origin of the product or the organic production methods. Regarding the former strategy, it exists a PDO for the local hazelnut: however, it is not required by the large confectionery industries. Hence only a very tiny share of the overall production is marked as PDO. Indeed, some operators feel that developing a PGI label could be a better strategy allowing them to expand the demand to processors also outside the region. However, there is a growing awareness and concern that is expected to gradually lead to the start-up of local micro activities as well as developing a project to shift to a PGI. Limited is also direct sales.

From a policy point of view, the regional authority (*Regione Lazio*) did not intervene to manage this process decisively. In contrast, it has signed an agreement with one of the mail confectionary industry supporting the establishment of new plantations. In contrast, the region, by means of its Rural Development Program, is supporting the introduction of eco-friendly practices. The introduction of such practices is also supported by means of the programs of the POs. Because of this, the use of integrated pest management is nowadays spread. In contrast, the production of organic hazelnut is very limited. Some municipalities where hazelnut has been introduced and is rapidly expanding have introduced restrictions to the expansion of the new plantations, new wells as well as the use of some chemicals and crop practices. However, farmers' organizations and POs have taken legal action challenging the decisions of the municipalities some of which have been removed.

Growing societal demand for eco-friendly practices

As it has been described, there is a growing movement against the expansion of the cultivation of hazelnut. So far, the actions did not have a relevant direct implication on the trend. However, it seems very likely that in the future the situation will change, and more binding environmental constraints will be introduced. This is expected to reduce the level and quality of production leading to a reduction of farm revenues and, consequently, farm income and economic viability. This is also expected to lead to increased volatility of farm results, as well as an overall reduction of the profitability of investing in new hazelnut plantations. This may have negative consequences on the quality of life in the area because also the local downstream operators will be negatively affected leading to a negative impact on the gross saleable production in a short time. However, it is not possible to foresee how relevant these phenomena will be. In contrast, this may lead to generate an increasing use of eco-environmental practices as well as an expansion of organic production. This may lead to the involvement of young people in sustainable agriculture: the latter being more attractive than conventional farming. The extent of this phenomenon will depend on how the FS will be able to effectively communicate the shift to "eco-friendly production methods" and by how much consumers will be the willingness to pay a price differential for such products. In contrast, the introduction of more binding environmental constraints would have a positive impact on the environment, allowing to ameliorate the link between natural and local capital by maintaining natural resource in good conditions and by protecting the biodiversity of habitats, genes and species. Overall, this may support a more balanced, diversified and sustainable rural development in the study area (Reidsma et. Al., 2019).

Very few actors of the FS do anticipate this possible challenge. So far, the activities seem to go "business-as-usual". This refers to both farming practices and new investments.

So far, the FS actors are coping by resisting the attacks from local environmental groups completely rejecting their claims and pursuing a firm opposition to any of the proposed changes. In contrast, environmental groups have expanded the political pressure by enlarging the environmental campaign to the national and international levels.

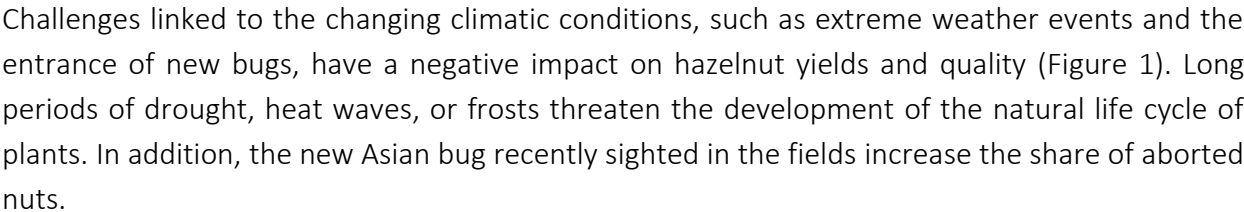
Few operators (both farmers and downstream operators) are taking this challenge as serious. Most of them because have done so out of personal conviction, others because of they like to pursue a diversification strategy that allow them to move out from the established network linked to the demand of the large confectionary industries.

4 PATTERN ANALYSIS

This section presents the effects of the challenges on the FS and the enabling environment on the system functions and describes patterns across challenges. This allows identifying the systemic nature of the effects and the role of different actors and institutions. In the end, this is useful to show the complex effects that such challenges play on the FS resilience.

Four of the previously mentioned challenges affect the stock of natural resources. These can reduce the provision of environmental services that are part of the public functions played by the system. Two other challenges may have negative implications on the autonomy of the system. This is seen as constraining the resilience of the system to possible future shocks. These two groups of challenges are described graphically using different casual loop diagrams referring to two different system archetypes (Kim, 2000).

Figure 1 – Consequences of four challenges affecting the FS and its relations with the environment.



Farmers implement adaptation strategies to improve their economic performance (e.g. the profitability of farmers and the enabling environment): irrigation to resist long drought period and chemical treatments against bugs. Such strategies allow to balance the effects of the previously mentioned challenges and, in particular, allow to maintain satisfactory yields and product quality. However, these strategies put under pressure the natural capital especially groundwater and air quality. The former is becoming an increasingly scarce resource. The latter can be threatened by the pollution generated by the chemical treatments. This is expected to reduce the environmental

sustainability of the FS and can have negative consequences on the health of the residents and on other agents operating in the area but not directly involved in the FS as the agents operating in tourism activities. In addition, in the long run, the depletion of natural resources could also have negative effects on the producers too. This is due to the increasing opportunity cost of water extraction, although it is not possible to make predictions given the limited scientific evidence on the topic.

The growing quality standards required by the confectionary industry can negatively affect the economic results of those farms that are not able to meet such standards (Figure 1). Indeed, the price paid to producers is modulated according to such standards that makes the confectionary industry unlikely to buy products below a given quality level. This becomes a relevant incentive for farmers taking actions to increase product quality as already seen. While ensures farm economic performance (e.g. profitability), this loop is in contrast with the preservation of natural resources and the environmental sustainability of the FS.

The reduction in the profitability of other crops is, also, another challenge that affects the provision of public functions. The FS is adapting to this situation by increasing the specialization on hazelnut production and this allows to maintenance of high farm profitability. Hence, the FS adapts very well to this challenge in this regard. In contrast, the subsequent high production specialization results in increasing pressure on natural resources and threaten environmental sustainability. This is due to a reduced overall biodiversity and a negative effect on the landscape less diversified. However, a growing specialization seems to reinforce the negative effects generated by the two previously discussed challenges.

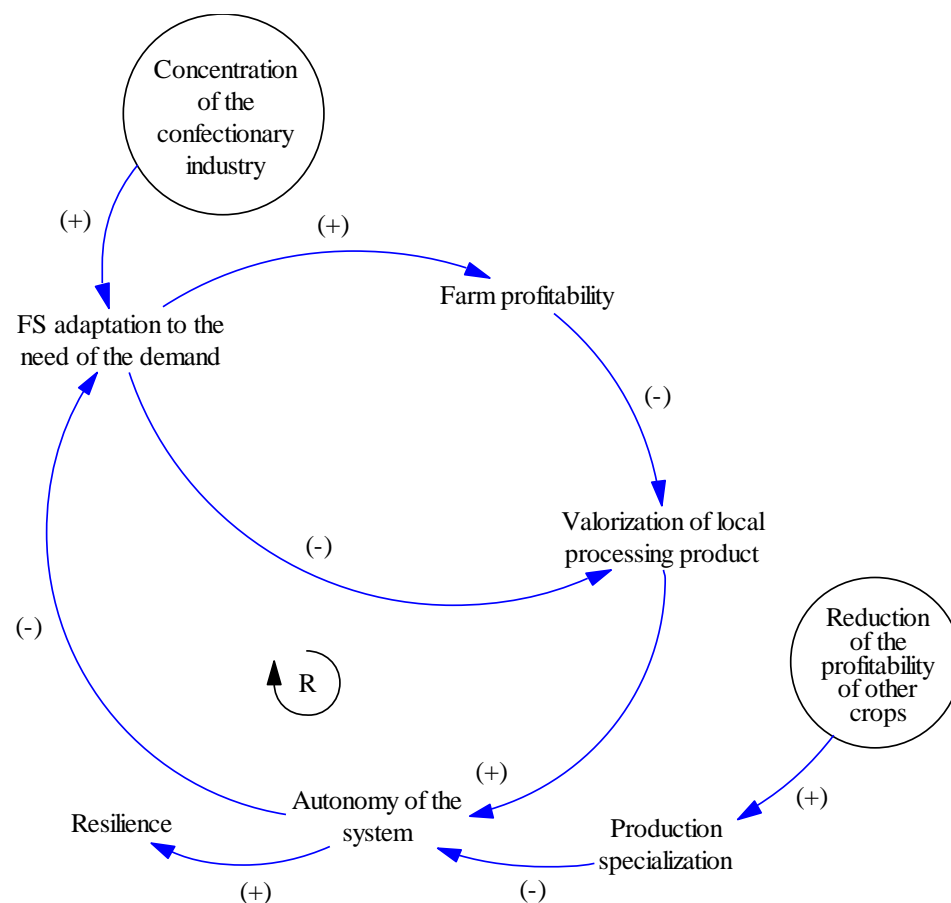
In this regard, it is useful to underline that both extreme weather events and the entrance of new bugs, and the growing demand for high quality standards are synergic. Both challenges negatively affect the environmental sustainability of the system if no corrections are taken. Furthermore, the growing specialization of the FS is expected to exacerbate the problem. The realization of the three challenges at the same time has therefore the potential to generate a not negligible reduction of the provision of public environmental functions.

This is the background that motivates the growing concern represented by some environmental groups and some municipalities. They demand stopping the expansion of hazelnut cultivation, for larger use of eco-friendly production practices and for introducing constraints to some production practices potentially harmful for the environment and the local residents (Liberti, 2019) (Figure 1). This is seen as a challenge because it may reduce farmers' reputation, can negatively affect farm profitability, reducing the room of maneuver in terms of the range of adaptation strategies toward the previously seen three challenges, as well as posing a halt to the growth of the business

of post-farm local operators. In contrast with the previously described three challenges, imposing tight production constraints is expected to reduce the provision of private functions but to reduce the pressure of the FS on the natural capital.

The good performance of the confectionery industry has been able so far to ensure a growing demand for hazelnut and a positive trend in prices. Therefore, this has been a key factor in ensuring so far the viability of the system. However, the confectionery industry is increasingly concentrated, and this allows it to have high bargaining power. This causes growing concern because the confectionery industry has the power to influence the production choice and marketing strategies of the FS. Indeed, the post-farm operators (especially the local POs) have been capable to adapt to the changing needs of the confectionery industry (Figure 2).

Figure 2 – Effect of the concentration of the confectionery industry and reduction of the profitability of other crops on the autonomy of the system.



This adaptation strategy has guaranteed an increase in the economic profitability of farmers who sell raw hazelnuts and, more in general, it has ensured the profitability of the overall FS over time. In this regard, such a strategy had very positive implications for the provision of private goods and the economic success of the FS. However, the positive results of these strategies have avoided that the FS evolved also toward a strategy based on the valorization of the product locally. For example, very few post-farm local operators process hazelnuts or sell hazelnuts and hazelnut-based products using the logo of the PDO “Nocciola Romana”. This had the indirect effect of reducing the degree of diversification and of autonomy of the FS. In this sense, the process reinforces itself because being able to adapt to the changing needs of the confectionery industry allows ensuring high profitability over time. Therefore, while this has not so far caused negative consequences on farm profitability, this may reduce the room for maneuver in case the confectionery industry will change its buying strategies in favour of other production areas.

Note that the reduction of the profitability of other crops, leading to a higher production specialization, exacerbated the process that leads to a reduction of the autonomy of the system (Figure 2).

The reduction of the autonomy of the system, making farmers more vulnerable to decisions taken elsewhere, together with the permanent nature of the crop which implies an intrinsic slowness to change, makes the system vulnerable and, according to some of the stakeholders involved in the workshops carried out within the project, reduces its resilience.

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D6.1 NETHERLANDS

Work Performed by P1 WUR

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1 Farming system and enabling environment

The Veenkoloniën is an arable farming region with peat soils where starch potatoes and sugar beets are the dominant crops (Prins et al. 2011). Winter wheat is cultivated in order to maintain and improve the soil quality, rather than due to profitability (Immenga et al. 2012). While farms specialising on arable crops prevail, there are also a few mixed farms in the region. The Veenkoloniën supply 42% of the Dutch and 11.4% of the EU production of starch potatoes (Kuhlman et al. 2014). Most farmers in the region are members of cooperatives (ibid.). Several big cooperatives based in the Veenkoloniën also operate worldwide. AVEBE specialises in starch potatoes globally with a focus on Dutch and German markets; Cosun Beet Company (formerly known as Suikerunie) is a sugar beets cooperative, and part of the processor Cosun; Agrifirm is the main wheat processor and primarily delivers into the feed industry. Yet, due to a high degree of co-dependency with farmers, only Avebe is included into the farming system; other cooperatives belong to the enabling environment.

Table 1. Actors in the Veenkoloniën arable farming system and its enabling environment

Actor	Farming system	Enabling environment
Arable farmers	X	
Livestock farmers	X	
Farm household members	X	
Avebe (starch potato cooperative)	X	
InnovatieVeenkoloniën	X	
Water board	X	
Regional agri-environment cooperatives, e.g., Agrarische Natuur Drenthe, Agrarische Natuurvereniging Oost Groningen	X	
Cosun Beet Company (sugar beet cooperative)		X
Agrifirm (wheat processor and feed supplier)		X
Provinces of Groningen and Drenthe		X
Ministry of Agriculture, Nature and Food		X
European Union		X
WUR incl. experimental farm Valthermond in the region		X
Farmers' labour organisation, e.g., Abiant and LTO-Noord		X
Environmental organisations, especially those criticising use of herbicides, e.g., Natuur en Milieu Federatie Drenthe, Natuur en Milieu Federatie Groningen		X
Financial institutions, e.g., Achmea/Interpolis and Rabobank		X

Besides some cooperatives, the enabling environment of the FS in the Veenkoloniën includes local and European policy makers, research, environmental and financial institutions, as well as farmers' labour organisation. These institutions cover all four resilience processes highlighted in the SURE-Farm framework: government, agricultural practices, economy, and farm demographics.

Table 2. Actors in the Veenkoloniën arable farming system and its enabling environment and the related formal and informal institutions

Actors	Formal institutions	Informal institutions
Enterprise domain: Arable farmers Livestock farmers Avebe (starch potato cooperative)	Contracts	Informal norms and patterns of collaboration between arable and livestock farmers Informal networks
Government domain: Water boards Province Ministry LNV European Union	EU CAP – Direct income support (Pillar I) and Rural Development (Pillar II) (co-financed by national governments) EU Water Framework Directive and Nitrates Directive and national implementation (Dutch: <i>Meststoffenwet</i>) EU Habitats Directive and the Birds Directive (Natura2000) Legislation on plant protection products (European Regulation (EG) No. 1107/2009; de Wet gewasbeschermingsmiddelen en biociden (Wgb)) Legislation on food safety and quality (European Regulation (EG) No. 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (PbEG L 31); De Nederlandse warenwet) Constitutional competences of the Provinces and the ensuing regulations	Dutch governmental vision on Agriculture (Dutch: <i>Visie kringlooplandbouw</i>) National transition visions (energy transition, protein transition) Informal networks between farm system actors and policy makers, mediated through interest groups, political parties, other societal associations, and private contacts and encounters

	Statutory competences of the Waterboards and the ensuing formal resolutions	
Intermediary domain: Cosun Beet Company (sugar beet cooperative) Agrifirm (wheat processor and feed supplier) Farmers labour organisation Achmea, Rabobank and other financial institutions	Contracts	Informal norms of reciprocity that mobilise assistance in case of need, e.g. diseases Informal associations that enable regular encounters and trust-building, e.g. study clubs
AKIS domain: InnovatieVeenkoloniën WUR incl. experimental farm Valthermond in the region Research/innovation projects (agro kalender noord nederland; http://www.agroagendann.nl/)	The Dutch Rural Development Programme (POP) (InnovatieVeenkoloniën is partly financed by national/provincial government and CAP Pillar II).	Informal networks and knowledge exchange between FS and AKIS actors, e.g. study clubs Shared cognitive and normative beliefs, e.g. perceptions of FS problems and visions on farming
Household domain: Farm household members Non-farm neighbours	Formal intra-household contracts, e.g. marriage, inheritance contracts, debt guarantees	Norms of reciprocity and solidarity within farm households Shared cognitive and normative beliefs, e.g. problem perceptions and visions on farming
Civil society domain: Environmental organisations	Formal memberships Formalized commitments	Norms of reciprocity Shared cognitive and normative beliefs

2 Challenges and adverse events in the last 10 years

Table 3 provides an overview of the major challenges in the farming system in the last ten years.

Table 3. Overview of challenges in the arable farming system in the Veenkoloniën in 2010-2020.

Challenge	Type of challenge	Potential (and <i>actual</i>) impact
Abolishment of EU CAP support for starch potato in 2013	Shock ¹	<ul style="list-style-type: none"> Decrease in farm income Decrease in starch potato supply Increase in prices (<i>actual impact</i>)
Wet year 2013	Noise	<ul style="list-style-type: none"> Starch potato yields were 6.5% lower than the average yields in 2010-2019 (<i>actual impact</i>; CBS, 2020 for Groningen) Increase in food prices (<i>actual impact</i>)

¹ Although it was gradual abolishment, the announcement was a shock.

Drought in 2018	Noise	<ul style="list-style-type: none"> • Higher N-surplus as less N is taken up by plants (<i>actual impact</i>)
		<ul style="list-style-type: none"> • Decrease in farm income • Decrease in food supply (<i>actual impact</i>) • Increase in food prices (<i>actual impact</i>) • The lowest starch potato yields within the latest decade: 16.7% lower than the average yields in 2010-2019 (<i>actual impact</i>; CBS, 2020 for Groningen) • Decrease in financial reserves of Avebe (<i>actual impact</i>) • Higher N-surplus as less N is taken up by plants (<i>actual impact</i>)
Drought in 2019	Noise	<ul style="list-style-type: none"> • Starch potato yields were 8.2% lower than the average yields in 2010-2019 (<i>actual impact</i>; CBS, 2020 for Groningen) • Increase in food prices (<i>actual impact</i>) • Decrease in financial reserves of Avebe (<i>actual impact</i>) • Higher N-surplus as less N is taken up by plants (<i>actual impact</i>)
		<ul style="list-style-type: none"> • Decrease in farm income • Decrease in food supply (<i>actual impact</i>)
Nematodes	Noise	<ul style="list-style-type: none"> • Decrease in farm income • Decrease in food supply (<i>actual impact</i>)
Low farm income	Trend	<ul style="list-style-type: none"> • Decrease in food supply
Missing farm succession	Trend	<ul style="list-style-type: none"> • Decrease in food supply • Decrease of number of farms (<i>actual impact</i>)
Trend towards more intensive farming methods	Trend	<ul style="list-style-type: none"> • Aging farmers population (<i>actual impact</i>) • Nematode pressure (<i>actual impact</i>) • Decrease in soil quality (<i>actual impact</i>) • Decrease in biodiversity (<i>actual impact</i>) • Water deficits (<i>actual impact</i>)

2.1 Institutional challenges

Between 2013 and 2019, the coupled support for starch potato production provided under the Dutch national implementation of the CAP was gradually abolished, putting pressure on farm incomes. According to Immenga et al. (2012), direct payments would have decreased from initially 450-750 €/ha (coupled support) to eventually 350-400 €/ha (decoupled support incl. greening payment) by 2019. Abolishment of policy support could also have cut down starch potato supply.

2.2 Environmental challenges

The Veenkoloniën possess neither well-developed water retention nor enough water drainage capacity, making the region sensitive to extreme droughts and rainfalls (Prins et al. 2011, pp. 19-22). Potatoes – the most profitable crop – are particularly vulnerable to extreme weather events (Diogo et al. 2017, Table B.1). If the period between July and September is warm and wet, there is a high risk for potatoes to be infected by *Erwinia* spp.; if the period between May and September is rainy, potato fields are commonly affected by late blight caused by *Phytophthora infestans*, which causes yield losses and reduced quality (Schaap et al., 2013); wet conditions between August and

October mainly affect harvesting, e.g., by limiting access to fields. 2013 was a particularly wet year, while 2018 and 2019 were characterised by severe drought throughout Europe. As Figure 1 shows, starch potato yields fell by 6.5%, 16.7%, and 8.2% in 2013, 2018, and 2019 respectively, compared to the 2010-2019 average (CBS, 2020).

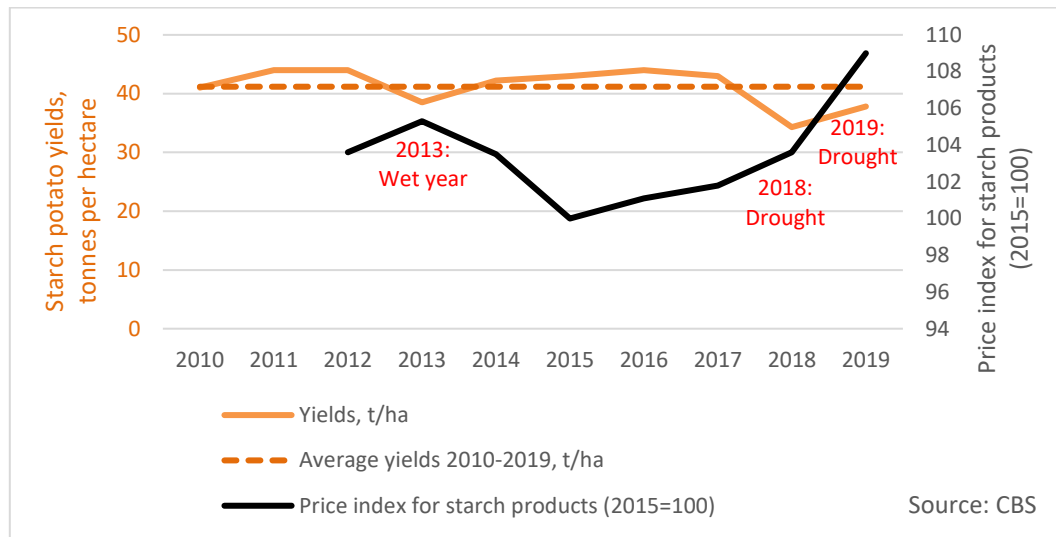


Figure 1. Starch potato yields in the province of Groningen and price index for starch products in the Netherlands, 2010-2019. Source: CBS, 2020

The currently implemented 1:2 rotation² for starch potato is too intensive and results in a high risk of plant-parasitic nematodes, which in turn also causes yield reduction and reduced quality. All environmental challenges in the farming system negatively affected yields, with potentially negative impacts on farm incomes.

2.3 Economic and social challenges

Both institutional and environmental challenges were aggravated by generally low margins and difficulties in finding farm successors. More specifically, according to Diogo et al. (2017), net present value per hectare of arable land in the farming system is amongst the lowest ones in the Netherlands. Furthermore, current agricultural practices are focused too much on production, while being partly decoupled from local and natural production capital. For instance, maintaining and improving soil quality is undermined by current strong dependency on intensification of arable farming. Provision of public functions, especially maintaining natural resources, protecting biodiversity and increasing attractiveness of rural areas in terms of agrotourism and residence, is characterised with low performance (Paas et al. 2019). There is a trend towards even more

² The most narrow rotation is a four-years-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.

intensive farming methods. Due to low farm income and low soil quality, many farmers opt to intensify agricultural practices, which has negative environmental impacts, instead of looking for more sustainable options.

3 Response analysis

Response of the farming system to abolishment of EU CAP support for starch potato in 2013 included solely coping measures, which were quick enough to kill any incentives for adaptation at the FS level. More specifically, Avebe quickly adapted its business model and developed new products with higher added value, incl. potato protein for human consumption, which led to higher prices for farmers and compensated for gradual abolishment of policy support. The performance price increased from 75,07 euros per tonnes of starch potato in the year 2013/2014 to 96,63 €/t in the year 2018/2019 (Avebe 2019; 2018). In this case, the major resilience attribute was the strong interdependence of Avebe and farmers facilitated by the strong focus on starch potato production. Although sugar beet is the most profitable crop in the farming system on hectare basis, it is characterised by a very restrictive 1:4 rotation, meaning that only 25% of land could be devoted to sugar beet. Therefore, starch potato is the main cash crop in farming system, and hence farmers are also generally reluctant to reduce or abandon production of starch potato.

Table 4. Overview of responses to the major challenges in the last ten years

Challenge	Anticipation	Coping	Adaptation	Resilience attributes and enabling environment
Abolishment of coupled support under national implementation of the CAP for starch potatoes in 2013	The policy change was widely anticipated and announced by the Dutch government (first proposal of changes was presented in 2011)	Avebe managed to increase prices via a number of innovations in production and marketing Rotation at farm level intensified	None. Avebe's actions made adaptation at the FS level not necessary	Strong cooperation between farmers and Avebe Strong focus of the FS on starch potato (the only cash crop in the FS)
Wet year 2013	Farmers were more or less prepared, as these shocks occur regularly	Financial savings from previous years. In 2012, starch potato yields were 6.8% higher than the average yields in 2010-2019 (CBS data for Groningen)	Measure to improve soil quality Abandonment of low-laying fields Improvement of water levels for higher laying fields	Involvement of the local water board Water framework directive: more or less fixed water levels to work with, rather than tailored solutions.

		Also, higher prices compensated reduced harvest Fungicide application against late blight Selection of late-blight-resistant varieties	Maintain regional water drainage capacity	Constraining resilience attribute: limited crop rotation and low farm income
Drought in 2018	Farmers were more or less prepared, but this was an extreme shock requiring further adaptation	Loss of farm income was bridged with financial savings from previous years. In 2014-2017, starch potato yields were above the 10-years-average (CBS data for Groningen) Also, higher prices made up for reduced harvest (natural hedge), some farmers even benefitted	Farm diversification (non-farm activities) Improving soil quality to increase water holding capacity	Insurance Constraining resilience attribute: limited crop rotation and generally low farm incomes, limited options to irrigate
Drought in 2019	Farmers were more or less prepared, but this was an extreme shock requiring further adaptation	of farm income was bridged with savings from previous years. In 2014-2017, starch potato yields were above the 10-years-average (CBS data for Groningen) Increase in price Fungicide application against late blight Selection of late-blight-resistant varieties	Farm diversification (non-farm activities) Improving soil quality to increase water holding capacity	Involvement of the local water board Constraining resilience attribute: limited crop rotation and generally low farm incomes, limited options to irrigate
Nematodes	Farmers are more or less prepared, as these shocks occur regularly	Loss in farm income was bridged with savings Selection of new resistant varieties of starch potato Improved crop rotation via collaboration with livestock farmers	Improved crop rotation via introduction of new crops, e.g., blueberries Use of green manure, i.e., leaving uprooted or sown crop parts to wither on a field	Collaboration of arable and livestock (dairy) farmers Openness to innovation and collaboration with the WUR experimental farm in the region Constraining resilience attribute:

				limited crop rotation and low farm income Constraining and adding to the previous: a wider rotation will only show effects in the long-term, at least 5 years, but probably more. Limited knowledge is available on this.
Low farm income	Everyone is aware about the issue with often too optimistic expectations about higher prices in the future	Financial savings in the short- run, does not work in the long-run. (need to adapt?)	Introduction of new (high-value) crops, improve soil quality	Direct area-based payments and other government support for arable farms under the CAP
Farm succession	General discussion in farm circles about lack of successors. No broader public or economic debate on the issue. No general consensus about the underlying factors apart from formulaic complaints. Lack of succession is often due to highly individual reasons in connections with more general structural factors such as the perceived lack of attractiveness of life in rural areas or of jobs in the farm sector	Individual arrangements at farm level	Long-term structural concentration processes Farm enlargement at individual level	Constraining: Government support for farm income under the CAP is often seen as an impediment for newcomers since the payments are capitalized on land markets. Enabling: Higher CAP payments for young farmers, agricultural schools, presence of nearby towns (e.g. Emmen)

Major coping strategies in wet year 2013 were natural hedging due to higher market prices and the use of financial savings from previous years to compensate the income shortfall. More specifically, in 2012 and 2014-2017 potato yields were higher than the ten-year-average, and farmers could accumulate financial reserves. As for late blight due to rainy summer, the usual coping treatment is fungicide application, often on a weekly basis. Actually, half of the fungicide applied in the Netherlands is used to control late blight in potatoes (Pacilly et al. 2018). This has

negative effects on the public image of potato production. Due to its dependence on fungicides, the farming system is also vulnerable to changes in legislation on crop protection substances, products and application procedures. Another important coping strategy against late blight is the breeding of more resistant varieties (Pacilly et al., 2018). With regard to adaptation, active work is led by the local water board to improve soil quality and water levels in fields, as well as to maintain regional water drainage capacity (Hunze en Aa's 2020). Also, ongoing search for alternative crops to extend crop rotation can be seen as adaptation strategies. Similar to wet years, natural hedging and financial savings were the main coping strategies against drought in 2018 and 2019. Also here, improving soil quality is important adaptation strategy. Furthermore, farmers opt for greater diversification and expand non-farm activities. In case of extreme weather events, active involvement of the local water board, as well as pricing policy of Avebe allowing financial savings in good years and natural hedging in bad years, are the main components of the enabling environment.

Financial savings and resistant varieties are also key coping strategies against nematodes. Furthermore, arable farmers collaborate with livestock farmers in the region by combining their lands and hence extending crop rotation to reduce the risk of nematodes. This collaboration is usually not based on any contracts, but solely on trust, and hence implies well-developed networks in the farming system that can be recognised as a part of the enabling environment. Arable farmers also adopt new crops, in order to extend crop rotation. Some crops are not innovative anymore (e.g., onion – coping strategy), others are fairly new with no well-established market (e.g., blueberries – adaptation strategy). Also, use of green manure is an adaptation strategy: for instance tagetes are cultivated to effectively control specific nematode populations (Nieuwe Oogst, 2020). Openness of farmers to innovation makes the uptake of novel ideas from the enabling environment more likely, and the experimental farm of Wageningen University & Research located in the farming system and the local farmers organisation InnovatieVeenkoloniën facilitate adoption of innovation and distribution of good practices.

When talking about all environmental challenges, it is worthwhile to highlight constraining attributes of the FS as well. Due to limited crop rotation and crop portfolio, there are few diversification options. Furthermore, generally low farm income substantially limits financial savings, although at the same time being maintained by a high share of starch potatoes (cash crops) in the crop portfolio.

4 Pattern analysis

In responses of the farming system to all the challenges considered above, two archetypes can be observed: *shifting the burden* combined/*exacerbated by limits to success*.

Although the response of Avebe to abolishment of EU CAP support for starch potato production can be seen as a remarkable example of resilience, it was also an example of a quick symptomatic solution to maintain farm income and starch potato production. At the same time, the more fundamental problem, namely strong dependence of the farming system on starch potato production, was not addressed. Even though this might be seen as a comparative advantage, the current system is also sensitive to multiple challenges, as observed in the past. At the same time, the response powered by Avebe removed any potential incentives to move away from strong specialization on starch potato production by adopting other crops or activities. Limited experience of moving away from strong specialisation on starch potato also leads to scarce information about alternative crops and markets, hence only constraining any potential transformation. For instance, there is limited knowledge on how potato yields could increase in the long term in wider rotations, while actual yields are estimated to be roughly 40% lower than potential yields (Rijk et al. 2013; 2019). This difference is partly explained by the negative impact of nematodes.

Similarly, shifting burdens can be observed in responses to extreme weather events and nematodes. The major focus is put on maintaining food production and farm income by compensating income losses with financial reserves with the use of resistant crop varieties. Yet, both are rather symptoms of more fundamental problems, namely climate change and unsustainable intensive farming. At the same time, provision of public goods, such as protecting biodiversity and maintaining natural resources in good conditions, is neglected and suffers even more from strategies aiming to maintain or improve provision of private goods. There is some attention for improving soil quality and water availability but this is insufficient in the long-term.

Multiple loops of shifting burdens have helped to constantly improve performance in food production and maintain sufficient farm income, yet also driven the farming system to its limits. Financial reserves of Avebe are at their limits, and Avebe might not be able to pay farmers high enough prices to remain viable (Schütz 2020). Tight crop rotation cannot be intensified even more, since limited number of livestock farmers in the Veenkoloniën makes future cooperation between arable and dairy farmers to reduce nematodes risk uncertain. Furthermore, innovative starch potato varieties were recently found not to be resistant to new nematodes, so farmers might not be able to maintain the level of starch potato production. System dynamic modelling and participatory workshop confirm that even a marginal intensification of, e.g., an extreme weather event would lead to abolishment of starch potato production and hence a drastic system decline, possibly even collapse (Schütz 2020).

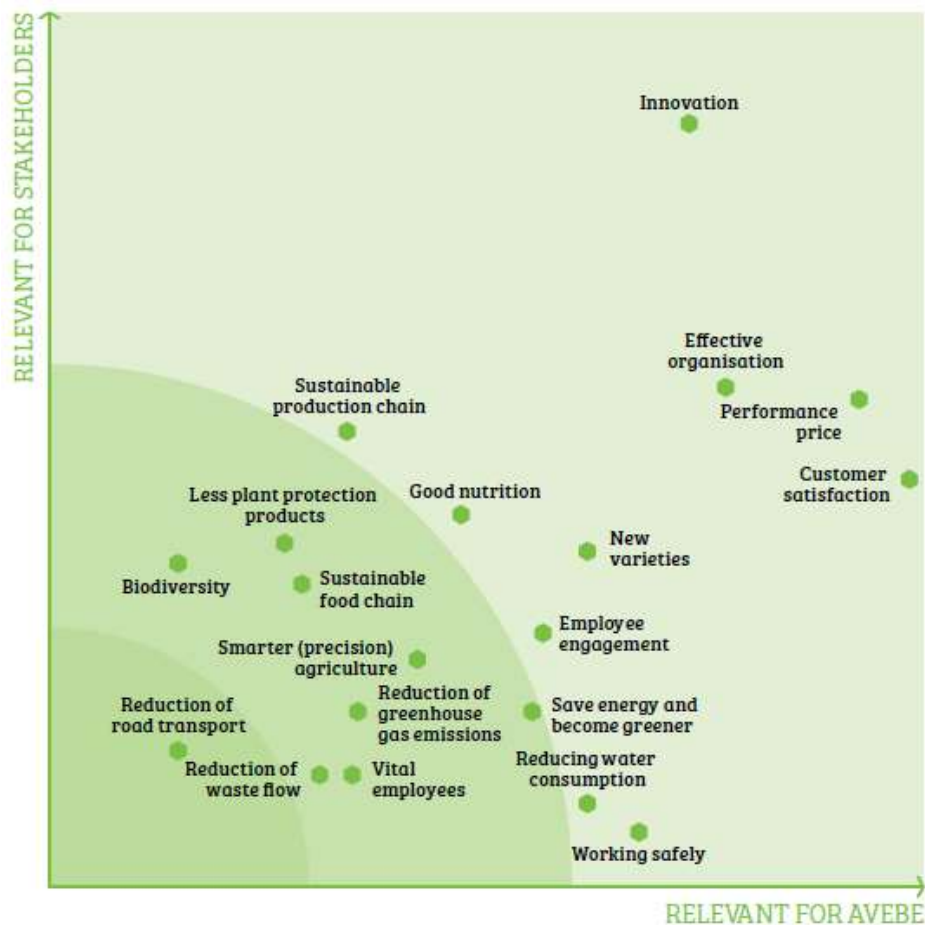


Figure 2. Relevance of different aspects of starch potato production for external stakeholders (including growers, customers, supervisory board, NGO, one local resident, scientists) and members of Avebe revealed via an online survey (source: Avebe, 2019)

Our analysis shows that Avebe is the driving force when responding to a challenge in the farming system. It aims to maintain the current specialisation on starch potato production and hence acts in order to quickly treat any symptom of a challenge, as well as any incentive to move away from specialisation on starch potato. When doing so, it exploits well-developed infrastructure for innovations and learning networks in the farming system, maintain regional employment opportunities and ensure sufficient income and working conditions (private goods, according to the SURE-Farm framework), while putting much less focus on provision of public goods. Figure 2 illustrates that indeed innovation, effective organisation and price are valued by Avebe much more than, for instance, biodiversity and sustainability.

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D6.2 POLAND

Work Performed by P15 IRWiR PAN

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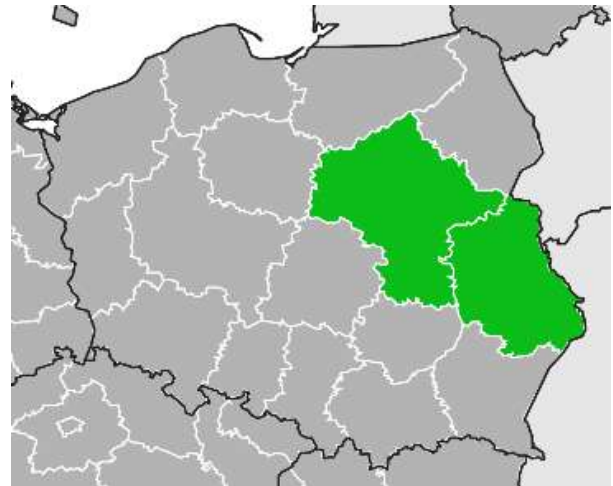


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1 Step 1: Farming system, its enabling environment actors and institutions

Agriculture in the Mazovian case study area (including two NUTS2 regions: PL92 - Mazowieckie and PL81 - Lubelskie) is predominated by several farming systems, among which is the analyzed horticultural farming system. This system is determined by the local diversified landscape, land fragmentation and historical traditions. Depending on the particular area of the region the key cultivated hard fruits are: apples, pears, plums, cherries, sweet cherries, and to a less extent peaches and apricots; among the soft fruits there are: strawberries, raspberries, currants (black and red), and gooseberries. Most popular vegetables chosen for cultivation by farmers are the following: onions, carrots, cabbages, cucumbers, tomatoes, and sugar beets.



The farming system consists mainly of the small family farms (under 10 ha), primarily those specializing in horticulture but also other farms providing manure supply or doing common crop rotation for those farms. Other actors include farm organizations, local financial institutions, insurance companies, retailers and other units which affect the farms and the farms also have impact on them. The farmers and the entire system face challenges – some inherited from the communist past (e.g., low cooperation due to farmers distrust and some other resulting from the global trends, e.g., extreme weather events). The system tries to sustain the essential functions and is doing well in delivering high-quality products and maintaining natural resources however struggles to ensure sufficient farm income, attractiveness of the rural areas and to protect biodiversity.

Among the key actors (Table 1) in the enabling environment are the government, which includes the EU level policy makers and various national entities implementing EU and state measures aimed at support of the agricultural sector. The AKIS plays an important role, as the farmers rely to a great extent on the services of the well-developed stated advisory service (CDR). There is also an increasing role of the labour intermediaries, including: Labour Office, domestic and foreign employment companies (also private). Overall the enabling environment is diverse and covers all possible issues concerning agricultural activities.

Table 1: Actors in the Polish horticulture farming system and its enabling environment

Actors	Formal institutions	Informal institutions
<p><i>Enterprise domain:</i></p> <p><u>Processors</u> LA-SAD, Sad Na Zapieckach, Wiatrowy Sad Grażyna Wiatr.</p> <p><u>Input suppliers</u> (Agrosimex, Syngenta Polska Sp. z o.o., Agrosimex, Syngenta Polska Sp. z o.o.).</p> <p><u>Technology providers</u> (Techsad, Kuhn, Arysta Lifescience, Longobardi, Greefa, Valdysa, Besseling).</p> <p><u>Wholesalers</u> (Tompres S.C., AGROSTAR group, POL-AGRO S.A., Świeży Owoc Sp. z o.o., Green Fresh, BUKAT, Sadex group)</p> <p><u>Retail</u> (Green Fresh, BUKAT, Sadex group).</p>	<p>Economic regulations, taxation, EU Cohesion policy, CAP</p>	<p>Economic relations</p> <p>Attitude toward cooperation</p> <p>Attitude toward advisory and technology</p> <p>Attitude toward retail</p> <p>Attitude toward environmental pollution (agricultural inputs)</p>
<p><i>Government domain:</i></p> <p>European Union, Ministry of Agriculture and Rural Development</p> <p>Ministry of Environment, KSOW, local self-governance.</p>	<p>CAP, Nitrates Directive</p> <p>Food Law, Water Directive, Green Deal, Farm to Fork, Climate Action</p>	<p>Awareness and acceptance of farmers</p> <p>Farmer participation</p> <p>Societal participation</p> <p>Pro-environmental activities</p>
<p><i>Intermediary domain:</i></p> <p><u>Producer groups</u> (Idealsad Sp. z o.o., Rozumki Sp. z o.o.),</p> <p><u>NGOs</u>: Association “Sady Grójeckie”,</p> <p><u>Farmers’ organizations</u> (Izby Rolnicze, Fundacja Europejski Fundusz Rozwoju Wsi).</p> <p><u>Labour intermediaries</u> (Labour Office, domestic and foreign employment intermediaries).</p> <p><u>Banks and financial intermediaries</u> (BGŻ BNP Paribas, Spółdzielczy, Santander, PZU).</p>	<p>Producer groups measure within CAP RDP.</p> <p>Employment regulations, minimal wage, work and residence permits for foreigners.</p>	<p>Informal producers groups or associations</p> <p>Informal (verbal) job agreements</p>
<p><i>AKIS domain:</i></p> <p>IUNG, IERiGŻ, CDR (advisory services), IRWiR PAN, SGGW, UW, Agricultural</p>	<p>SERiA, technical and technological support, Patents,</p>	<p>Best farming practices</p>

Universities, Main Inspectorate of Plant Health and Seed Inspection, FDPA	rural development directions, economic and market analysis	
Societal domain: <u>NGOs:</u> (International Union for Conservation of Nature - IUCN), agricultural media (farmer.pl, agropolska.pl), consumer unions	Green News, campaigns, anti-GMO movements	Societal expectation toward food quality and safety

2 Step 2: Identify challenges and adverse events in the last 10 years

- **Challenge 1: Russian embargo of 2014 (sudden shock).** In 2014 (8th of August) an embargo on exports to Russian market has been enacted as the country's response to EU sanctions, which had a strong short-term impact upon the Polish horticulture farming system. Prior to 2014 Russia has been one of the key consumers of Polish fruits and vegetables. The share of Russia in particular product exports included: apples 55%, tomatoes 49%, and cabbage 50%. For Poland, the banned products covered 70% of the value of agri-food exports to Russia and most severely affected fruit and vegetable sectors. The problem seems to follow the archetype named "shifting the burden" as defined by Kim (1992)- see chapter 4.
- **Challenge 2: COVID19 of 2020 (sudden shock).** The first appearance of COVID19 in Poland is dated of 4th of March 2020. Since then Poland introduced many restrictions, such as 2 lock-downs and many other concerning: people's movement, distance between people, covering mouth and nose in public places, quarantines, cultural events – restrictions, public transport regulations, religious ceremonies, gatherings and meetings, remote education, borders and international traffic, shopping centres and large-format stores, sport and leisure limitation, competitions and sports events limits, hotels and resorts regulations. That held for entire Poland, including our CS area. The shock follows the pattern "success to the successful".
- **Challenge 3: Extreme weather conditions (noise).** Past decades are showing an increasing number of extreme weather events challenging the agriculture. The occurrence and intensity of these events varies on a yearly basis, the most influential being the spring and autumn frosts, winds, droughts, hail, extreme winters and floods. Horticulture is one of the agricultural sectors highly vulnerable to such weather events, with all subsectors being prone to their influence (soft and hard fruits, vegetables). The development of the problem seems to be best characterised by the archetype "fixes that fail".
- **Challenge 4: Fluctuation of prices of agricultural products (noise).** Uncertainty and frequent changes of prices for agricultural products is a rather typical noise, yet stakeholders in Poland perceive it as one of the most influential challenges, as the profit margin is considered narrow, therefore with the price fluctuations leading to critically low profitability or unprofitability. It varies

greatly depending on the agricultural subsector, type of produce and seasonal changes, yet the constantly uncertain economic environment is often referred to as disturbing and causing unfavourable perception of agriculture as a whole, despite the CAP and other state support. This pattern the most resembles “drifting goal” archetype.

- **Challenge 5: Lack of seasonal workers (noise).** The lack of seasonal workers in a gradually growing problem that affects Polish agriculture. The processes of industrialization in the XX century followed by post-industrial changes have decreased the rural population employed in agricultural activities, as well as have caused major migration either to urban areas or abroad. Remuneration in agriculture is relatively lower compared to other sectors of Polish economy, which is decreasing the attractiveness of agricultural employment, especially on seasonal basis. The development of this challenge resembles the patten of “growth and underinvestment”.
- **Challenge 6: Demographic decline (trend).** The process of population ageing in Poland, also in its rural areas, which is relatively low compared to other EU countries, is drawing to an end because the coming years are expected to bring a considerable acceleration in that regard. This long-observed process is faster in rural areas than in cities. People in post-working age now account for nearly 25% of the rural population. The most unfavourable demographic conditions in our CS area in relation to national average are: natural decline (of -2.3 persons), low fertility rate (1.29), negative net migration (-0.3 per 1000 of rural population), relatively high number of persons from rural areas staying temporarily abroad (39.1 per 1000 people), shortage of young women in rural areas (925 per 1000 man), low employment rate (50.8%) and ageing population. According to Main Statistical office demographic forecasts for the years 2014–2050 the major consequences of these changes will be a spike in the value of the dependency ratio from 29 to 75 in the post-working age group per 100 population in working age. The problem is the best depicted by the archetype “growth and underinvestment”.
- **Challenge 7: Shortage of water resources (trend).** Droughts due to the increasing climate change are leading to long-term shifts in water availability, with the natural water catchments drying and water levels dropping. According to the latest state documents¹ and opinions of local stakeholders the shortage of water resources is one of key challenges in the upcoming decades, being a challenge for the national security and economy, as well as the agriculture in particular. The water shortage in Poland is and will be increasing with local peculiarities, leading to more drastic shortages in regions with large-scale agriculture. The trend seems to follow the pattern called “tragedy of the commons”.
- **Challenge 8: Bureaucracy and variability of regulations (cycle).** This challenge is cyclical and related, to some extent, to 7 year budgetary cycles of Common Agricultural Policy. Each budgetary cycle comes with new paradigms and regulations (e.g., from price support to land-related support, new

¹ State Ecological Policy of Poland 2030 (2019), https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/Polityka_Ekologiczna_Panstwa/Polityka_Ekologiczna_Panstwa_2030.pdf

measures, new procedures, etc.) which influences the domestic policies and procedures of national implementation of CAP. Also there is a process of self-learning and learning-by-doing of the EU and national officers. As the policy becomes more and more sophisticated also the procedures are usually more demanding (sometimes only at national level) and regulations may not fit all (e.g., some regulations are favouring the large farmers but not the small ones, or the other way round). The improvement of the CAP and other policies (better targeting, more efficient measures, more goal orientation) is sometimes perceived different from the point of view of the beneficiaries and/or stakeholders. They would like to see the policy more flexible, more taking into account their needs, simpler and faster procedures, fast and suitable regulations (e.g., on foreign workers), etc. So there is clearly effort to simplify the policy and improving its implementation but the system encounters a limit which is still under the expectations of the beneficiaries. Besides, implementation of more efficient and better targeted measures require more data, and more effort from the beneficiaries so that it is perceived by them as deterioration of the policy rather than improvement. It seems to follow the pattern of archetype “Limits to success” – see section 4.

3 Step 3: Response analysis

3.1 Challenge 1: Russian embargo of 2014 (sudden shock).

In 2014, 8th of August, a sudden, political shock occurred to the FS. It was introduction of the Russian Embargo on most of the agri-food products from the EU to Russia. It had strong economic consequences on European agricultural products; the embargo constituted 46.3% of the agri-food export, i.e. 5.5 billion EUR. For Poland, the banned products covered 70% of the value of agri-food exports to Russia and most severely affected fruit, vegetables, milk and its associated processed products, as well as meat and its products (Krasiński, 2015; Rosińska-Bukowska, 2015).

3.1.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. Possible impact on delivery of 4 private functions: “Economic viability” due to negative impact on price relation of fruit and vegetables in relation to input prices; “Bio-based resources” thorough decrease in share of fruit cultivation; “Quality of life” through decreasing income level of horticulture farmers; and “Food production” through pressure on increasing quality and healthiness of fruit so it would affect the area of ecological farmland. Also a possible impact on one public function – “Natural resources”, as changes in land use would be possible due to declining demand for horticulture products.

Actual impact. The negative effects upon the “Economic viability” and “Quality of life” have occurred in the first year of the embargo. The loss of key foreign market forced farmers to lower their prices below profitability levels, while storing maximum volumes of produce. At the same time the “Food production” function has led to more affordable domestic products for consumers.

3.1.2. Anticipation of the challenge

Anticipation of the challenge (if and how). It was unanticipated challenge. Although in the past, Russia used the economic measures for political goals but usually the negotiations helped in finding compromise. This time there was no common ground and the restrictions were introduced immediately, almost overnight with immediate effect on closing the borders for certain products from the Russian side.

Anticipation aiding to alleviate the potential impact on the delivery of system functions.

N/A.

Factors helping to anticipate the challenge:

- Actors and their actions: N/A.
- Institutions that are being used or implemented by the actors: N/A.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): N/A.

3.1.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Poland has been gradually increasing the exports to Russian market prior to 2014, consequently making it its key buyer of many horticulture products, especially in case apples.

The potential impact did not occur in case of functions such as “Bio-based resources” and “Natural resources” because the FS coped without changing the cultivated area and its share under horticulture crops.

Potential impact did occur in case of “Economic viability”, exporters have increased the volumes of horticulture exports to Belarus and Turkey, which were in fact indirect exports (re-exports) to Russia, therefore it was a measure to get around the enacted restrictions and deliver the products to the same buyers. Even though the scale of such exports didn’t fully make up for the losses of sales, yet helped to stabilize the situation and sell the harvested products. The “Quality of life” function has suffered due to the decrease in local employment of seasonal workers, and due to growing differences in nominal incomes per capita of rural and urban residents.

Factors helping to cope with the challenge:

- Actors and what they do/did: The actors in the farming system who have helped to cope were the **exporters** (wholesalers, retailers) who found the way to export the products to old markets (Russia) and new markets (Asia, Africa). **Intermediaries** (producer groups) invested in cold storage facilities. In the enabling environment, the **government** initiated the intervention purchases of perishable horticulture products and compensation. European Commission, Polish Ministry of Agriculture and Rural Development, Agency of Agricultural Markets (ARR) have enabled support the for producers.
- Institutions: economic regulations, EU Cohesion policy, CAP.

- Resources (invested/used/built): private and cooperative funds (farming system), EU funds (enabling environment).

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics. Lack of market diversification, insufficient producers' cooperation, delayed investments in storage systems.

3.1.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact did occur. The farming system itself has not changed. The changes that happened concerned included context actors (through diversification of importers, obtainment of new foreign consumers).

Factors helping to respond to the challenge:

- Actors: domestic wholesalers, producer groups, state and business export support entities.
- Institutions: adjustment to new trade deals (certification, etc.)
- Resources: human resources (personal abilities to make contacts, new trade deals, etc.).

Responses that have been implemented and changes in the farming system.

Market diversification, larger farms and producer groups were able to respond more quickly and search for the new markets, or for ways to overcome the embargo by reaching Russian market through third-countries.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

Short-term negative impact was due to low market diversification and inability to react adequately to new market conditions (i.e. relatively low investment potential of producer groups and other cooperatives).

3.2 Challenge 2: COVID19 of 2020 (sudden shock).

3.2.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. The burst of pandemic would potentially have impact on 4 private and 1 public function. As for the private functions, the possible immediate impact could occur on delivering healthy and affordable food ("food production" function) since the access to the shops and markets was limited due country-wide to lock downs. The function of ensuring "economic viability" was also threaten due to uncertain impact of such sudden shock on the prices, both of output and input prices, as well as on the availability of those products on the markets. Another function under danger was "bio-based resources" the horticulture products are perishable so it was not certain if the system can deliver on time the produce for food processing companies and if the farmers would not switch their activities to less risky production types. The function "quality of life" could possibly be impacted through the turbulences at the job market. Horticulture system is much dependent on the seasonal workers, including the immigrants, while the

covid19 pandemic limited the mobility of the people across the countries. As for the public function, the one affected could be “attractiveness of the area” if people stop travelling and agritourist sector could be under the difficulties.

Actual impact. The negative effects materialized in delivery of “food production” function and “quality of life” function. Due to lock downs, even if the food accessed the markets the prices were usually higher, so less affordable to the customers. Lack of foreign labour force also affected the FC. On the contrary, in case of “attractiveness of the area” the impact was positive, because people trying to avoid large hotels and resorts for the vacation abroad they switched to domestic, small and agrotouristic places as they were more remote from big squashes of people.

3.2.2. Anticipation of the challenge

Anticipation of the challenge (if and how).

The challenge was not anticipated in any way.

Anticipation aiding to alleviate the potential impact on the delivery of system functions.

N/A.

Factors helping to anticipate the challenge:

- Actors and their actions: N/A.
- Institutions that are being used or implemented by the actors: N/A.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): N/A.

3.2.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Potential impact did not occur in case of “bio-based resources” and “economic viability” and in case of “attractiveness of the area” it was just opposite to what was expected (it was positive).

Potential impact did occur in case of “food production” function and “quality of life” function because food delivery was delayed and it was more costly and some work has to be delayed (due to lack of fertilisers in shops as there was run on the shops for doing stocks, so some farmers were not able to buy enough of the needed inputs).

Factors helping to cope with the challenge:

- Actors and what they do/did: these were customers who helped to cope with the system, because first, they paid higher prices for the food products delivered in the pandemic, they also chose to go for vacation to agrotouristic places in the CS area.
- Institutions: The government introduced the holiday vouchers to encourage for domestic tourism, it also started reimbursing the COVID19 test which farmers had to pay if they invited the foreign workers.

- Resources (invested/used/built): public resources (from central government), private savings (of consumers).

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics.

System occurred most vulnerable first, in management of safe selling of food products. That most affected the shop sellers who had to close the shops without other opportunity to sell their products and consumers who had to buy lower variety of products and at higher prices. Second, the system was vulnerable in terms of smooth agricultural inputs delivery. That the most affected the farmers, because lots of inputs was bought for stock and it was not enough left for normal operations for those who were not able to buy it on time.

3.2.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact did occur in case of “food production” as the agricultural inputs disappeared from shops and the shops were shortly closed down also due to lock-down. However, the input sellers opened the sales on line, even those who did not have such options before. So the respond was due to IT system development by retailers as well as openness and trust of farmers to start buying on line. So it was behavioural and cognitive development - new skills learnt and new attitude adopted. As for “quality of life” the rural vs urban situation deteriorated as in case of urban workers the distant work was possible in many occupations while in farming this was not a case.

Factors helping to respond to the challenge:

- Actors: retailers by development of IT selling systems; farmers by increasing on-line purchase of inputs; consumers – choosing domestic agritourist offers.
- Institutions: labour offices by improving employment rules for foreign seasonal workers, foreign labour intermediaries by providing better and targeted information and lobbying for better employment rules in time of pandemic.
- Resources: private and public, human and financial.

Responses that have been implemented and changes in the farming system.

Consumers’ preferences – for domestic food and leisure; media campaigns – suggesting the choices of domestic food and leisure; farmers’ social networking and learning (also from each other); government aid policy for entrepreneurs – e.g., holiday vouchers, 3 months exemption from social security payments, etc.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

The first reason was lack of technology and proper management of the system. There was also no means of safe transport of food and inputs from abroad – the system is based maybe too much on the road transport which requires time and crossing borders. Maybe better air system or less-labour intensive transport would be a solution. Also some alternatives for shops (especially in hypermarkets, which were closed the longest time) would help to solve the problem of safe access to market and safe sales. The

farming system did not respond to consumers' needs for affordable food and there was no compensation to the prices;

Second reason was long procedures for seasonal workers. The farmers made their production decisions based on assumption that they will not have help from foreign workers so they started seeding less labour-intensive crops.

3.3 Challenge 3: Extreme weather conditions (noise).

3.3.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. Potential impact of the challenge is mostly local, seasonal and partial. While the challenge is referred to by the stakeholders as having a tremendous effect upon the production process and harvest results, the occasional and local occurrence of the challenge leads to fragmentary impacts. Thus the impact is difficult to estimate beforehand, yet it is substantial to those farmers who suffer from it. Thus it can be stated that not the whole farming system is prone to the negative potential impact at all times. At the same time the negative impact upon the part of the producers typically leads to price increase and thus positive economic effect for those producers, who were affected to a lesser extent or not affected at all.

Actual impact.

3.3.2. Anticipation of the challenge

Anticipation of the challenge (if and how). The challenge is anticipated on a regular basis, with the farmers monitoring the weather changes and forecasts.

Anticipation aiding to alleviate the potential impact on the delivery of system functions. Anticipation does aid as particular farmers choose to implement protection measures. These are different depending on the type of produce and stage of the production process, but they can help to decrease the negative effect. Watering in case of droughts, covering in case of hail or frosts, creating retention reservoirs in case of heavy rains. This is performed locally at the effort of the farmers in prevailing number of cases.

Factors helping to anticipate the challenge:

- Actors and their actions: media, AKIS, scientific institutions.
- Institutions that are being used or implemented by the actors: information flow, state-farmer cooperation through AKIS.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): scientific knowledge, short-term media forecasts, medium and long-term scientific prognoses.

3.3.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Potential impact does occur on a regular basis, as well as its occurrence is intensifying in the past decades. Coping with this challenge is prevalent to responding to it.

Factors helping to cope with the challenge:

- Actors and what they do/did: farmers, government, AKIS.
- Institutions: insurance, cooperation.
- Resources (invested/used/built): savings to cover the possible losses.

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics.

While the insurance is available, not many farmers utilize this option due to the costs and variability of potential risks. Therefore it can be stated there is no systemic approach to cope with the challenge, but it is done in a rather chaotic way, leaving most to the “chance”. As the extreme weather conditions so far occur irregularly and do a limited damage in most cases, farmers tend to take the risk and just endure.

3.3.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact does occur occasionally on the local level. In the national perspective it is happening on a regular basis yet affecting different areas. Therefore particular responses are taking place only in case of severe and regional damage, instead of partial and local. Otherwise farmers (and other actors) tend to cope with this challenge than to respond to it with systemic actions.

Factors helping to respond to the challenge:

- Actors: farmers, government, insurance companies.
- Institutions: cooperation.
- Resources: financial savings, insurance, state financial support.

Responses that have been implemented and changes in the farming system.

Response on the farmers’ side limits to local measures implemented on their farms, such as crop protection, adjustment of production practices. In case of severe damages it is possible to expect limited state financial support to rebuild or cover basic losses.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

Lack of systemic thinking and focused actions towards transformation of the farming practices disallow minimization of these risks. On the other side these risks are among the most unpredictable, with a varying chance of occurrence, as well as damage impact, therefore the financial means of protection seem to be most suitable. Yet farmers complain about the costs of the insurance and have been voicing an opinion that the government should help them with the insurance premiums.

3.4 Challenge 4: Fluctuation of prices of agricultural products (noise).

3.4.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. Fluctuation of prices for agricultural products arises from various factors, yet for the farmers it is one of the most substantial challenges itself. Fluctuation of prices is caused by all kinds of factors, while the most impact upon the price changes are the environmental and economic (causing swift changes in supply-demand relations, thus leading to almost immediate price changes), while the social and institutional factors have a rather long-term influence upon price trends.

Actual impact.

3.4.2. Anticipation of the challenge

Anticipation of the challenge (if and how). Anticipation of this challenge is difficult and is not clearly understood by most farmers. There is an understanding the price is an unstable phenomena, yet there's still a strong anticipation it would be stable and predictable. This contradiction leads to eventual profit losses by the farmers, who are "hoping for the best", but do not seek for practical solutions to overcome or minimize the potential negative effects.

Anticipation aiding to alleviate the potential impact on the delivery of system functions. In some cases anticipation of the price changes helps to avoid negative price change effects, but it is rather a chance than directed actions to help this to happen. Therefore the "Food production" and "Economic viability" functions are expectedly perceived as of low performance.

Factors helping to anticipate the challenge:

- Actors and their actions: media, AKIS, government.
- Institutions that are being used or implemented by the actors: not recognised.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): human capital (knowledge and ability to analyse the economic and market situation), infrastructural capital (in case of producer groups with storage and cold-storage capacities).

3.4.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Potential impact does occur on a regular/seasonal basis, as well as due to various economic or environmental shocks. The price of agricultural produce is highly volatile, therefore it is always expected, although the negative consequences are usually not assessed properly. Coping with this challenge is the most typical reaction, therefore farmers usually try to withstand it.

Factors helping to cope with the challenge:

- Actors and what they do/did: farmers, producer groups.
- Institutions: cooperation.

- Resources (invested/used/built): cheaper inputs, improving logistics, shortening the value chain.

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics.

While the cooperation between the farmers (and possibly processors) is one of the most efficient in case of this challenge, the level of cooperation is still low in Polish agriculture as a whole, as well as in the horticultural sector. The reason is the lack of trust (coming from the socialist era) and rather low willingness to combine resources with other people.

3.4.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact does occur regularly and affects the farmers, as well as other actors in the system. The farming system tries to respond, yet the most typical reaction is withstanding the risk.

Factors helping to respond to the challenge:

- Actors: AKIS, producer groups.
- Institutions: cooperation.
- Resources: human capital (knowledge and ability to analyse the economic and market situation), infrastructural capital (in case of producer groups with storage and cold-storage capacities).

Responses that have been implemented and changes in the farming system.

Despite the relatively low cooperation levels there are still quite a few producers groups and other types of cooperatives. The horticulture farming system is one of the better ones from this perspective, as during the 2000s and later years numerous producer groups were created in the central and eastern Poland, most dealing with hard fruits such as apples or pears. Some have invested in storage facilities or even cold-storage facilities, which help overcome the price fluctuation risks and achieve high economic viability for their members.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

Large fragmentation of the farming system actors (primarily farmers) and their high numbers lead to the single farmer responses, instead of cooperating and looking for joint measures to overcome the negative effects of the challenge. It is again the lack of cooperation and strong willingness to cooperate between the farmers that is keeping them from more demanding, yet more efficient measures.

3.5 Challenge 5: Lack of seasonal workers (noise).

3.5.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. Private function: "Food production" via impacted ability to supply the expected amount and quality of food products. Private function: "Economic viability" via labour costs (lack of seasonal

workers increases the costs per hour). Public function: “Attractiveness of the area” via balance of migration (high outmigration of residents).

Actual impact. The challenge has been materialising on the regular basis in the past three decades. In the 1990s the key reason for lack of seasonal workers was emigration of rural residents (mainly to Western Europe), in 2000s the growing income gap between the rural and urban areas have led to further outmigration to cities and increase of non-agricultural employment, while the 2010s have led to dependency mostly on foreign workers (yet this has its issues connected with increasing labour costs and foreign employment bureaucracy).

3.5.2. Anticipation of the challenge

Anticipation of the challenge (if and how).

This challenge has been voiced in most interviews given by farmers and it is definitely a permanent “noise” in the farming system they have been accustomed to in the past decades.

Anticipation aiding to alleviate the potential impact on the delivery of system functions.

Anticipation aids to search for ways to attract seasonal workers beforehand and assure their presence, primarily in the harvest season. Understanding of the issue by state officials helps to optimise regulations and bureaucratic requirements in order to simplify employment of foreign (primary Ukrainian) workers. Appearance of numerous employment intermediaries both on Polish and Ukrainian sides allows quick responses to urgent needs in seasonal employees.

Factors helping to anticipate the challenge:

- Actors and their actions: farmers, farmer organizations, AKIS.
- Institutions that are being used or implemented by the actors: immigration statistics and organizations.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): human capital.

3.5.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Potential impact did occur and is gradually increasing since the beginning of 1990s, as more rural inhabitants are migrating either to more urbanised areas or abroad. The key way of coping is the relative wage rise, but this measure is not enough to attract domestic workers of local population (as the relation to wages in other sectors is still not favourable).

Factors helping to cope with the challenge:

- Actors and what they do/did: farmers, government, employment intermediaries.
- Institutions: employment agreements (formal and informal), employment regulations and requirements, foreign workers’ residence and work permits.

- Resources (invested/used/built): human resources.

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics. Inelastic employment regulations, lack of domestic workers, low wages in agriculture.

3.5.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact did occur and is gradually increasing since the beginning of 1990s, as more rural inhabitants are migrating either to more urbanised areas or abroad. The key response in this matter is the attraction of foreign (Ukrainian) workers.

Factors helping to respond to the challenge:

- Actors: flexibility of foreign employees, active search for foreign employees by domestic and foreign employment intermediaries (through local and internet communication).
- Institutions: not recognized.
- Resources: human resources, internet communication between employment intermediaries and potential workers (primarily through internet forums and Facebook groups).

Responses that have been implemented and changes in the farming system.

Farming system has changed so that the foreign seasonal labour force has appeared as its actor.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

The system did respond, however inadequately with respect to time (too slowly) and scale (too restrictive sometimes). That partially affected the above mentioned functions to some extent.

3.6 Challenge 6: Demographic decline (trend).

3.6.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. Since it is the trend affecting a main production inputs (labour) it has a potential impact on many functions, 3 private and 3 public good function. As for the former, the aging and diminishing of the rural population can affect the “food production” function, it also can affect “economic viability” if there is a labour shortage, as the cost of labour could possibly increase in this situation. Third, “quality of life” could decline considerably since there is not enough people to make public investments profitable so there is a situation of underinvestment (in infrastructure, transport, etc.) and in this situation there is usually unfavourable, selective outmigration (especially of young people, more educated and especially women). Then quality of life is under the danger and the function is not delivered by the system either. As for public good functions, it is proved that younger generation is more considered of environment than the older one, so if there is a shortage of young farmers then “natural resources” function may be affected and similarly “animal health and welfare” function. If demographic decline materializes also the “attractiveness of the area” may be affected, however it is not predictable which way - are the depopulated

areas more or less attractive to the tourists? That depends on the outside situation (e.g., COVID-19 and gathering restrictions) and consumers preferences (do they like commercial or deserted places).

Actual impact has materialized in case of “economic viability”, because shortage of labour caused the labour cost to increased. That was to some extent alleviated by the cheaper workers from Ukraine but the difficulty in employing them affected the access to that labour for Polish farmers. The actual impact was also on “natural resources” function because the older generation experienced and anticipated the problems with succession which affected their land use decisions – they seed less labour intensive crops, and in principle they care less about natural resources than the younger generation, especially that they do not have long term vision if the farm is going to stop operating at their generation.

3.6.2. Anticipation of the challenge

Anticipation of the challenge (if and how).

The challenge was anticipated because it is a long term trend, so the speed and direction of the demographic changes is nothing new or unexpected for the Farming System.

Anticipation aiding to alleviate the potential impact on the delivery of system functions.

The anticipation helped in that way, that the Common Agricultural Policy initiated new mechanisms and measures addressed for younger generation and generation renewal (e.g., early retirement scheme, direct payments for young farmers, young farmer measure, etc.).

Factors helping to anticipate the challenge:

- Actors and their actions: farmers and their families talked about it openly, in surveys, interviews, so the agricultural researchers wrote books about it, media publicized the problem, and advisors were helping with the policy measures to address the problem.
- Institutions that are being used or implemented by the actors: statistical offices published surveys on the current and forecasted demographics situation.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): statistical analyses, media publishing, media programs (e.g., farmer searching for a wife, etc.), movies were screened showing the deterioration in demographics in agriculture.

3.6.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Potential impact did not occur in case of “food production” because the level of production was maintained due to mechanization of work, e.g., new combines for picking up barriers, also the strategy of replacing labour intensive crops with capital intensive ones worked well. In case of “quality of life” – CAP measures helped in maintaining and even increasing income disparity between rural and urban population and allowed also for infrastructural investments. “Attractiveness of the area” also rather gained because consumers’ preferences are towards more remote and more affordable places. “Animal health and

welfare” was not affected because the CAP’s requirements (conditionality for the CAPs funds) guarantee the obedience of the rules so the generation differences in attitude did not matter that much.

Potential impact did occur in case of “economic viability” and “natural resources” as the farmers’ strategies were only partially able to take actions against the demographic changes. Some farmers used the CAP measures – e.g., early retirement scheme and “young farmers” within RDP to encourage younger generation to stay. The younger generation seek for higher profitable horticulture products or change the production into other type (less demanding). So the land use structure changes too.

Factors helping to cope with the challenge:

- Actors and what they do/did: government.
- Institutions: CAP and national institutions, Retirement Policy, national program for early retirement, Preferential credits for young farmers.
- Resources (invested/used/built): regulations, knowledge, policies.

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics.

It seems that coping mechanisms are outside of the FS, so the solutions are much determined by policies, regulations, law (e.g., succession law), CAP measures directed to generational renewal, etc.

3.6.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

In this case it was rather coping than responding, because the factors which are needed for responding are still not developed as explained below.

Factors helping to respond to the challenge:

- Actors: farmers’ changing mentality (should be treating farms as business rather than a heritage, so become more eager to sell the farm rather than relay on family successors). Young farmers’ schemes should be increased and more available to farmers, not only from CAP but also supported by national policies.
- Institutions: succession law should allow earlier retirement to farmers so that the young ones could easier take over the farm.
- Resources: regulations (e.g., the new Land Act of 2016 in Poland) puts many restrictions on agricultural land turnover and agricultural land is not a good collateral any more for bank credits. Farmers Social Security Fund (KRUS) is also an obstacle - all farmers are eligible for special fund, which has preferential payments; Young people living on farm even if they are not owners of the farm are eligible for that support too, which however does not allow them to combine work on farm with other occupations (that is sometimes restrictive to their income generation).

Responses that have been implemented and changes in the farming system.

No changes in the farming system as such was observed. Rather outside FS, the institutions and EU policies were helpful.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

N/A.

3.7 Challenge 7: Shortage of water resources (trend).

3.7.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. Water shortage is a growing trend, as more and more global and Polish studies show. Shortage of water could lead to loss of harvest and affect the agricultural production system as a whole. All depends on the length of the drought, which in a very short perspective leads to shortage of local water resources.

Actual impact. Year 2020 was one of the most dry years in the past decades, with the above average temperatures between March and November and rainfall shortage.

3.7.2. Anticipation of the challenge

Anticipation of the challenge (if and how).

The understanding of the challenge is growing among the farming system's actors, mostly due to scientific research and media. Before the shortage of water was perceived as a rather occasional weather consequence, and it is only in the past decade more is talked about on the systemic climate change, anthropogenic impact upon the climate and the expected intensification of the adverse climate change effects for agriculture. Still not all of the society treats this seriously, therefore there are mental obstacles to implementation of measures aimed at climate change mitigation and adaptation.

Anticipation aiding to alleviate the potential impact on the delivery of system functions.

Slowly the understanding of the permanent nature of this challenge sets in, mostly due to information flow within the media and government taking a position towards the water shortage problem. Therefore slowly the water retention measures are starting to be implemented, yet it is only the beginning and the results are still not changing the bigger picture.

Factors helping to anticipate the challenge:

- Actors and their actions: scientific institutions, EU authorities.
- Institutions that are being used or implemented by the actors: transfer of knowledge.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): not recognized.

3.7.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

Potential impact did occur in 2020.

Factors helping to cope with the challenge:

- Actors and what they do/did: government, media, farmers
- Institutions: not recognized.
- Resources (invested/used/built): farm savings, state budget, EU funds.

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics.

The climate change is a global issue that affects Poland as much as many other EU countries. Therefore, not much could have been done to minimize the occurrence of the challenge and its potential impact.

3.7.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact did occur.

Factors helping to respond to the challenge:

- Actors: government, scientific institutions, AKIS.
- Institutions: financial support, transfer of knowledge.
- Resources: state budget, EU funds.

Responses that have been implemented and changes in the farming system.

Polish government has been supporting the farmers who suffered from the water shortage. AKIS is the one aiding the farmers to obtain the state support and find ways to respond to the challenge. Scientific institutions monitor and convey prognoses to the farmers to evaluate the water levels and possibilities to respond to the challenge.

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

Water shortage is a global issue that has been deepening regionally. Poland is a country with moderate water supply, yet due to the climate shift and accompanying rising temperatures and droughts, the water supply is declining. It is a systemic problem that will need adequate solutions on the EU and state level, with the farmers rather leading the pinpointed solution strategy than being the leader in adaptations.

3.8 Challenge 8: Bureaucracy and variability of regulations (cycle).

3.8.1. Potential and actual impact of the challenge on delivery of system functions.

Potential impact. The Common Agricultural Policy and its regulations potentially impact all the system functions, so when it becomes more complex, bureaucratic and changes over time then it potentially can affect them in the following way:

- “food production” – via standards for defining the healthy food. Actually the Polish standards used to be higher in some products while in the other the CAP forced very important adjustments.
- “bio-based resources” – via the regulations on processing sectors standards
- “economic viability” – via regulations on production inputs requirements – some of the plant protection products have such high standards that can be bought only from abroad and they are more costly which affects the input/output price ration and profitability. Also the conditionality of payments based on higher and higher environmental requirements puts some (especially small farms) in position that if they do not introduce new practices they may not be eligible for any CAP support.
- “quality of life” – in positive way via income support to farmers, thought direct payments and RDP measures which help in improving rural/urban income disparity.
- “natural resources” - via RDP programs and conditionality of CAP support.
- “biodiversity and habitat” as well as “attractiveness of the area” – are affected by the RDP measures, their requirements and types of funding, eligibility etc. (especially the large measures such as LFA support, early retirement in the past, etc.).
- “Animal health and welfare” – via cross compliance requirements and other regulations.

Actual impact is very diversified. In case of the farms which heavily rely on the CAP support all the changes in measures, regulations, requirements and controls heavily affect the delivery of the functions by them. If they do not manage to adjust or are not eligible then it is a negative impact (usually on the private functions they deliver). However, there is also a positive impact because the conditionality of support based on “good practices” and “cross-compliance” has a positive influence on all public good functions. Even farms which are not large beneficiaries of CAP but need to comply with EU requirements on e.g., inputs standards, are affected. The interviews showed that in our CS the standards for inputs – i.e. environmentally friendly plant protection products – caused the situation that the list of eligible products became very short and those products need to be imported from abroad. They are not only more costly and less available but also less effective than the old-fashion products.

3.8.2. Anticipation of the challenge

Anticipation of the challenge (if and how).

This challenge was anticipated as it repeats cyclically, at least with each new budgetary year of CAP (so in 7 year cycles of 2000-2006; 2007-2013; 2014-2020; 2021-2027). That Anticipation aids to alleviate the potential impact on the delivery of system functions to some extent.

Anticipation aiding to alleviate the potential impact on the delivery of system functions.

Factors helping to anticipate the challenge:

- Actors and their actions: based on experience of advisors, farmers and farmers’ associations in use of CAP support is communicated formally (through public consultations) and informally (through

lobbying the Ministry of Agriculture). They ask for simplification and taking into account the difficulties that they encountered.

- Institutions that are being used or implemented by the actors: Ministry of Agriculture and Paying Agency establish the working committees with participation of researchers and policy stakeholders; also the Monitoring Committee of RDP meets regularly and discusses the monitoring and evaluation of the policy.
- Resources that actors used/invested/built (social capital, financial capital, economic capital, human capital, infrastructural capital, cultural capital, symbolic capital, ...): the main resources are human and knowledge building and learning from both sides – beneficiaries and policy makers.

3.8.3. Coping with the challenge

Occurrence of the potential impact and ability of the farming system to cope.

So far the potential impact occur only to very small extent, because the system is coping by learning of all actors: advisors who make mistakes in applications learn new rules over the 7 year budgetary period and improve the applications. Policy makers learn which measures do not work so they change over time the eligibility and application rules of the measures. Farmers learn – e.g., their awareness of environmental protection increaser – so they become more eager to start new environmentally friendly practices.

Factors helping to cope with the challenge:

- Actors and what they do/did: all actors learn, they cognitive and behavioural changes are visible across all actors.
- Institutions: extension services, Managing Authority, Paying Agency cooperate with farmers and other policy stakeholders and collect their comments and complains.
- Resources (invested/used/built): **establishing rules for networking and communicating** the problems with policy measures from both sides – on one side, the institutions communicate about the problems and abusing of the CAP policy and b ; **building places / platforms for expression of competing interests** (e.g., Monitoring Committee of RDP); **establishing other forums where stakeholders can meet** – research conferences, workshops, etc.

Vulnerability of the farming system (in case of occurrence of the potential impact) and lacking characteristics.

The vulnerability of the system is based on human side (knowledge of people, willingness for cooperation, political cycles) – e.g., the communication between institutions managing, applying and monitoring CAP versus stakeholders depends quite a lot on which political party is ruling and openness of Ministers, as person and as a political part representative.

3.8.4. Response to the challenge

Occurrence of the potential impact and ability of the farming system to respond.

Potential impact did occur.

Factors helping to respond to the challenge:

- Actors: Farmers learnt to use to much higher extent the services of the advisors; Advisory services developed much beyond public services so the new private advisory companies entered the FS. Policy makers learned to listen to beneficiaries, they started their own and ordered research on implementation of the policy. Researchers – started to learn more sophisticated ways of doing evaluations (e.g., based on Common Monitoring and Evaluation Framework, and also evaluations started to be studies by researchers as topics of studies and dissertations).
- Institutions: New research departments were established (in Managing Authority and Paying Agency) to monitor and survey the problems of the beneficiaries; Evaluation standards were increased to investigate details of the policy implementation. Policy planning improved and was established with help of Public Consultations process. Universities and other higher education institutions introduce evaluation of rural, agricultural and regional policies as a new study topic.
- Resources: human capital; know-how absorption from abroad; some financial funds from CAP were devoted to capacity building within Managing Authority.

Responses that have been implemented and changes in the farming system.

Actually the above actions by actors assured that the absorption of the CAP is very good in Poland. So actually not so much the changes in the composition of the farming system takes place but the cognitive and behavioural changes (learning, awareness, cooperation, etc.). However, there is a side effect which is manifested in frustration of the beneficiaries and their complains that the policy is more and more demanding, more focused on the public good functions (which they value less) than on private functions (which are crucial to them).

Reason for inability of the farming system to respond (in case the potential impact did occur) and the lacking characteristics.

However, there is a limit of the “user-friendly” policy while it is developing into more complex, better targeted and more efficient policy. That is a case of “limits to success” archetype (see chapter 4). From the point of view of the beneficiaries the easier and more accessible measures the better but there is a trade-off between “easy” policy and “good” policy. The Polish policy makers have to obey the EU rules and build the bureaucracy to assure that no funds from CAP will be in danger of paying back. There is a case of competing interests. Policy makers want to optimize absorption of the funds but respecting the restrictions they face from outside, i.e. EU and quality of the Polish institutions (sometimes low human capital and not sufficient institutions or inconsistent law). Beneficiaries on the other side want to maximize the income and the aid from CAP, and they face the difficulty of “chasing the bunny” so once they learn some rules and become confident and start benefiting from the CAP, the rules change and they are frustrate again because they need to understand, adjust and learn the new rules.

4 Step 4: Pattern analysis

The system archetypes, as defined by Kim (2000) seem very useful in understating the way the system reacts to the above challenges. We could classify the events analysed above into the following archetypes (Table 2).

Table 2: Challenges in the Polish horticulture sector and their characteristics

Challenges	Type of challenge	Good or bad resilience	Type of archetype
1. Russian embargo of 2014	Sudden shock	Good and responding	Shifting the burden
2. COVID-19 of 2020	Sudden shock	Diversified	Success to the successful
3. Extreme weather conditions	Noise	Bad	Fixes that fail
4. Fluctuation of prices of agricultural products	Noise	Bad	Drifting goals
5. Lack of seasonal workers	Noise	Diversified	Growth and underinvestment
6. Demographic decline	Trend	Good but only coping	Growth and underinvestment
7. Shortage of water resources	Trend	Bad	Tragedy of the commons
8. Bureaucracy and variability of regulations	Cycle	Good by coping and responding	Limits to Success

Limits to Success archetype. Below is an example when the farming system has demonstrated **good resilience** in case of challenge “8. Bureaucracy and variability of regulations” because the potential impact occurs only limitedly and the farming system is generally able to anticipate, cope and respond. The system follows the archetype “Limits to success”. The farming system does perceive “bureaucracy and variability of regulations” as a challenge. The algorithm of the problem is depicted in Figure 1.

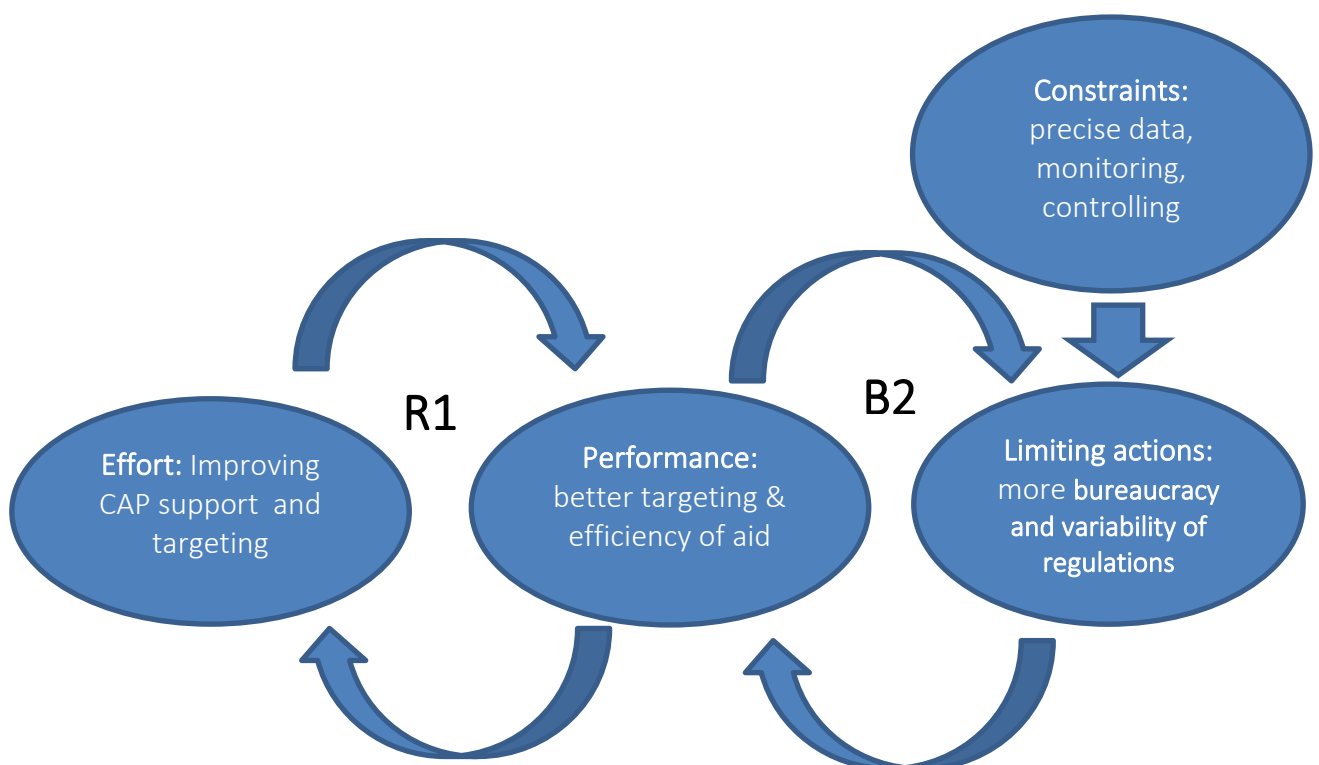


Figure 1. “Limits to success” in case of cyclical challenge of “bureaucracy and variability of regulations”

The policy undertakes an important EFFORT for improvements aiming at benefiting the FS. Those benefits are in terms of: 1) better targeting – e.g., by addressing certain groups like young farmers, or addressing better environmental issues by more conditionality; 2) higher efficiency - by redefining the measures, e.g., from “easy money” such as lump sum payments to investment subsidies, e.g., it was a case of young farmers schemes. However, despite the fact that those goals are achieved by the policy, but that results in LIMITING ACTIONS of higher bureaucracy because such improvement require more precise data, constant monitoring and controlling the implementation, which all in all CONSTRAINS the system, leading to higher bureaucracy and adjusting the regulations which become more variable from the point of view of beneficiaries. So the success is increased targeting and efficiency but it is limited by the increased bureaucracy and variability of regulations that it all requires. The farming system tries to cope and respond but there is a growing stress and frustration which comes from no-understanding of the beneficiaries why the aid system has to be so complicated to pay for simple functions and services they provide. All in all, improvements of the policy has its limit because it results in higher complexity for the beneficiaries who have problems with coping and responding to it in short time. However, in long time, both sides – beneficiaries and policy makers – learn and the limit is shifted a little bit.

Fixes that fail. Another example is the challenge of the extreme weather events, which demonstrates bad resilience, as the system recognizes the challenge and expects it, yet does not undertake proper actions hoping it would not happen after all. The farmers are the ones endangered by the extreme weather events, yet they keep stating the insurance costs are too high and in most cases don’t insure their agricultural activity or crops. Therefore in case of mild negative consequences of extreme weather events they usually withstand the losses, while in case of the severe damages they apply for the government financial support (B1), which fixes the consequences of the challenge’s impact, yet doesn’t help in perspective to create preconditions to be ready for the next challenge of the same type. Therefore after the situation is solved farmers still don’t reach out for insurance, thus risking again. This has negative impact both upon the farming system’s delivery of essential functions, as well as is potentially depleting state budgetary resources. This means that the “fix” doesn’t fix the problem, but compensates the losses of ones (farms) at costs of others (public taxes). The enabling environment helps with the challenge, but the farming system doesn’t take actions to fix it by utilizing all possible responses.

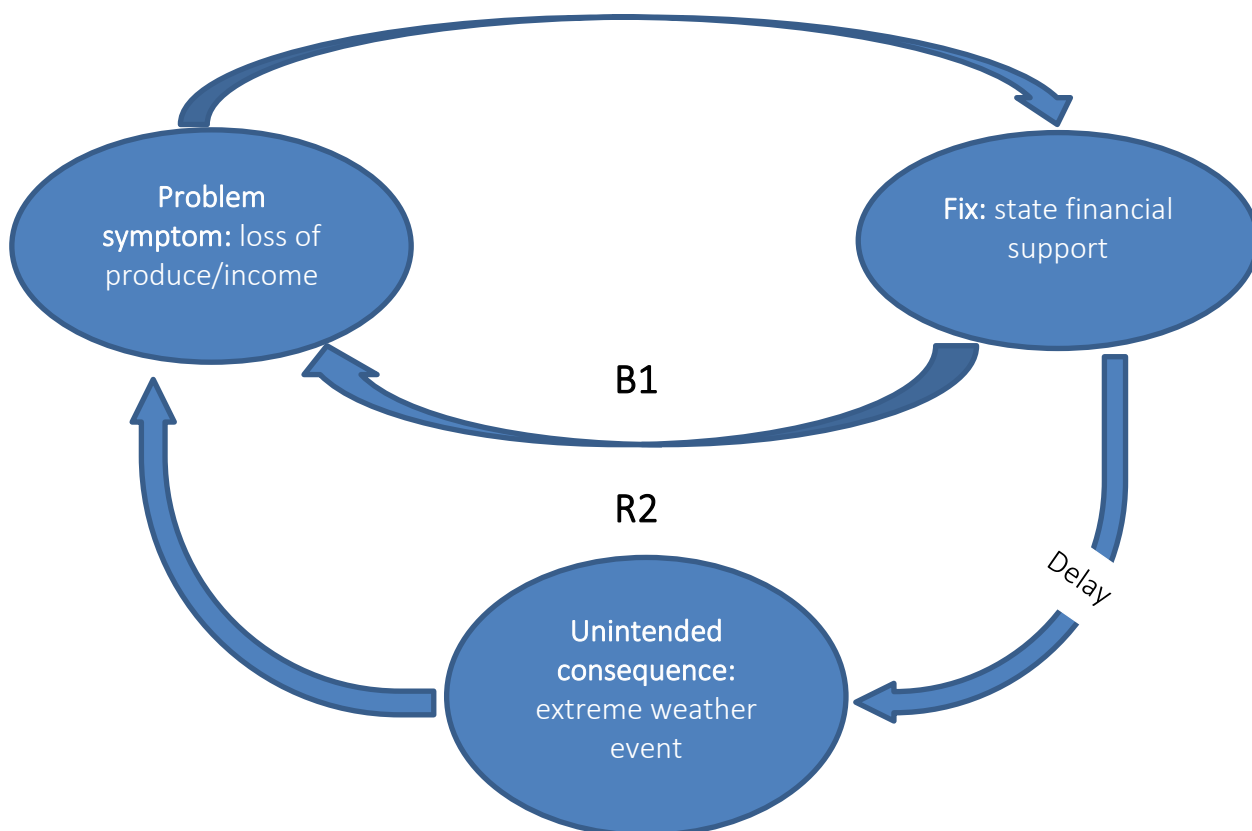


Figure 2. “Fixes that fail” in case of noise challenge “extreme weather events”

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D6.2 ROMANIA

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1 FARMING SYSTEM AND ENABLING ENVIRONMENT ACTORS AND INSTITUTIONS

The Nord-Est Region is the largest region in Romania in terms of area (15.5% of the total area of the country) and population (16.5% of the total population of the country) (Eurostat). More than half of the population (58.4%) lives in rural areas. The landscape is very diversified, and includes mountains, hills and plains. The climate conditions vary along altitude and landscape, from mountain climate to temperate-continental climate. The low hills and plains are exposed to extreme weather events, mostly frequent droughts.

The low hills and plains are favorable for a very diversified range of agricultural activities. Besides the agricultural area (2.12 million ha, representing 57.7% of the total region area) there is an important forest area (1.23 million ha, that is 33.4% of the region area). The agricultural area includes 65% arable land, 32.6% grassland, 1.5% vineyards and 0.9% orchards. The main crops are maize, wheat, sunflower and vegetables; the region produces also important quantities of fruits and wine. Livestock is composed mainly of cattle and sheep, pigs and poultry. In the last two decades, bee farming developed as well.

The actors involved in the farming system and enabling environment of small mixed farming in the Nord-Est of Romania have been identified through the interviews and focus groups for *Deliverable 2.3 - Report on farmers' learning capacity and networks of influence in 11 European case studies* and *Task 2.4 - Focus Group on Risk Management Strategies*.

Individual farmers are the main actors in the system, and important characteristics of the small farming system are: reduced economic and land size, fragmentation of land in operation, diversified production structure. The farmers' attitude towards cooperation / association is a negative one, which makes small farms having weak (if any) market bargaining power in relation with upstream and downstream actors in the value chain, restricts their ability to integrate into the market, to manage risks (e.g., in the construction / management of common irrigation systems), also makes them vulnerable and unrepresented in the political dialogue.

Key actors in the enabling environment are the policy makers at EU and national level, the national and local administration, the Ministry of Agriculture and Rural Development with its local branches, as well as all the Agencies implementing the policies and support measures for the agri-food sector (table 1). Local Action Groups and NGO-s also became active actors of the enabling environment in the last decade. The banking-financial and insurance systems are less important actors of the enabling system, since the small farmers generally avoid working with them, unless obliged by the rules of NRDP (National Rural Development Program) measures implementation. Internet, specialized media, research units and consultancy are the main information sources for farmers. Traders (intermediaries who take products from the farm gate and then sell them to



consumers or processors) are generally perceived negatively by small farms, as being profiteers, making easy money. Also, retailers and processing industry are guided by the principles of economies of scale and less interested in spending resources to capitalize on a fragmented primary production of small farms.

Large farms, through their associative (representation) forms, are part of the external environment of the small farm system in the NE region. They are highly specialized, vertically and horizontally integrated, present and vocal in the political dialogue. All this gives them comparative advantages in the competition for resources.

Table 1: Actors in the Nord-Est small-mixed farming system and its enabling environment

Actors	Formal institutions	Informal institutions
Enterprise domain: <ul style="list-style-type: none"> Individual farmers Farmers' cooperatives / associations / producer's groups Input suppliers (technology, fertilizers, pharmaceutical) Traders Processing industry Retailers Banks Insurance companies Real estate agents 	<ul style="list-style-type: none"> Individual companies Associations/cooperatives Good and service providers Market integrators 	<ul style="list-style-type: none"> Attitude towards cooperatives / association Negotiating power Attitude towards service providers and intermediaries Attitude towards loans and insurances Short food supply chains / direct sales
Government domain: <ul style="list-style-type: none"> EU National/Central administration Local administration County agricultural authority (branch of the Ministry of Agriculture and Rural Development) APIA (Agency for Payments and Intervention in Agriculture) AFIR (Agency for Funding the Rural Investments) ANSVSA - DSV (National / county Sanitary Veterinary and Food Safety Authority) Organic certification bodies 	<ul style="list-style-type: none"> CAP Regulations (Nitrates Directive, Water Directive, neonicotinoids regulations, etc.) Regulations for accessing funds from NRDP (National Rural Development Program) Sanitary-veterinary regulations Food safety regulations Economic and financial regulations Fiscal (taxation) regulations Payment agencies 	<ul style="list-style-type: none"> Decision making Awareness and acceptance from farmers Accountability Farmers' participation

Actors	Formal institutions	Informal institutions
Intermediary domain: <ul style="list-style-type: none"> Producers' organizations (PO) Advisors / consultants LAG (Local Action Group) 	<ul style="list-style-type: none"> Public advisors Private consultancy 	<ul style="list-style-type: none"> Attitude towards POs Food chain management Governance Expert groups Advisors groups
AKIS domain: <ul style="list-style-type: none"> Research organizations Input developers Vocational schools Specialized radio/TV broadcasts Social media / Internet 	<ul style="list-style-type: none"> Knowledge and innovation developers Training institutions Technology advisors Media (TV, radio, internet) 	<ul style="list-style-type: none"> Attitudes towards technologies Attitudes towards education / training Good farming practices
Societal domain: <ul style="list-style-type: none"> People on the farm / family members Other farmers Customers Civil society (World Vision) 	<ul style="list-style-type: none"> Farmers' communities Consumers' organizations Citizens Media companies 	<ul style="list-style-type: none"> Societal vision on farming Environmental attitudes Consumers preferences Attitude towards social support

2 IDENTIFY CHALLENGES AND ADVERSE EVENTS IN THE LAST 10 YEARS

For the identification of the challenges faced and currently facing the arable sector in the Nord-Est of Romania, we used the data collected through the SUREFARM survey conducted in November and December 2018 in 122 small mixed farms in the case study region. More specifically, the challenges have been identified by analyzing two questions of the questionnaire developed by the SUREFARM consortium:

- Question 3a. Considering the next 20 years, what do you expect to be the 3 most important challenges on your farm? (Open question)
- Question 5. Considering the next 20 years, to what extent do you think that the following events will be challenging for your farm? Please circle your answer on a scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm).

Results are presented in Table 2. The selected challenges from Table 2 have affected the farm system in Nord-Est region as well in the past, as evidenced by the FOPIA & AgriPoliS workshops and farm demographic interviews with regional stakeholders.

Table 2. Main challenges of the small-mixed sector in Nord-Est Romania

Challenge Category	Specific Challenges	Type
Climate changes	Extreme weather conditions (drought)	Noise / trend
Markets	Poor integration of small farms in agri-food chains	Trend
Business	Business development	Trend
Business	On-farm diversification and integration	Trend
Labour supply	Lack of available labour	Trend
Policies	Change of agricultural policies / regulations	Noise / cycle
Markets	Price scissors	Trend

2.1 Challenge 1: Extreme weather conditions (noise)

Among the climate risks, droughts are most frequent in Nord-Est region. The frequency of droughts increased in the last two decades because of climate change. Their influence is strongly negative on the agricultural production; a reduction in the level of the output means that the volume of sales is even more reduced, since in most small farms, part of the output is consumed on farm.

Frequent droughts coupled with the lack of irrigation infrastructure and lack of insurance instruments tailored to the needs of small farms results in frequent years with production losses. Droughts significantly diminish the feed availability for livestock, pushing up the costs which are

not covered by the price of meat and milk. Overall, with losses incurred in almost half of the years, the small mixed farming system is very vulnerable to extreme weather conditions.

2.2 Challenge 2: Poor integration of small farms in agri-food chains (trend)

The Land Law of 1991 dismantled the communist-type cooperatives and restituted the land to the former owners. Consequently, a huge number (more than 4 million in all Romania) of small farms emerged. Most of the farmers had certain agricultural skills, but their knowledge and experience in management and marketing was very limited or none. The breakup of the previously existing product chains (disappearance of wholesale enterprises, privatization of processing and of retail) resulted in a mismatch in size of actors along the supply chain: very many small farms producing agricultural goods, while input suppliers, wholesalers, processors, and retailers went through concentration processes. As a result, farmers have a low bargaining power in the supply chains, and poor access to markets.

In time, farmers were (and still are) very reluctant to cooperation and association, therefore product supply is very dispersed. Most older farmers are opposing openly to association, and younger farmers are not well informed or educated in this direction, except for those who worked abroad in farms in western countries and saw first-hand the advantages and opportunities offered by association. The current situation is that even though many farms are included in various types of associations, most of these associations (such as the ones of animal growers) are in fact just formal ones. Farmers just pay a very small annual fee to get a membership certificate which is an eligibility condition for applying for animal subsidies.

Currently, marketing channels are rather limited for the small farms. The channels depend on the type of product. For vegetables and fruits, farmers are mostly selling directly to urban customers in organized and permanent “wet markets”, in local fairs, or, if the villages are located further away from urban localities, to various traders (middlemen) which offer generally very low prices. Milk and dairy products are sold in the same wet markets, or directly to consumers (using clients lists). Selling contracts are used if the farms are in the proximity of local processing units, but these sales decreased in the latest years due to low prices and an important competition from imported products. The large processors prefer to use imported agricultural raw materials (milk from Hungary, meat from Poland, etc.), which are cheaper than the local products, and push down the prices, thus making some farmers to quit raising animals for meat or milk production. Large retailers also prefer to import fresh fruit and vegetables rather than by them from local producers, due to the lack of supply concentration.



An important part of the small farms output is used for the family consumption and as on-farm input as feed for their own livestock.

2.3 Challenge 3: Business development (trend)

The greatest opportunity in the sector came along with the country's accession to the EU, and the integration of common agricultural policies, which came with important financial support for investments, modernization and development of farms and other economic operators involved in the agri-food products supply chains.

At the time of its accession to the EU (January 1, 2007) the Romanian farming system was significantly less technologically developed as compared to the Old Member States and even compared to some of the New Member States. The Agricultural Census and Structural Agricultural Survey data show that the vast majority of the farms in Romania are small farms (less than 5 ha) and 95% of the total number of farms have a SO<8000 EUR (Eurostat, 2016 data).

Romanian small farmers are increasingly aware that they need to develop and increase their presence on the markets; there are two major directions to achieve that: increasing the size of their farms (by purchasing and/or leasing land and investing in livestock); and implementing technological and managerial improvements to increase productivity, sales, and income.

After accession, in the first programming session (2007-2013), developing farm business by using projects funded through NRDP measures started modestly, despite the increasing interest and availability of funds. Lack of information, bureaucracy, farmers' low capacity and knowledge to write good applications, corruption and incompetence of the civil servants in the funding agencies contributed to difficult access of small farms to NRDP funding for business development.

Land operation consolidation increased in the region after the accession to the EU and the implementation of the CAP direct payment system. Land consolidation was positively perceived by most participants in both FoPIA-1 and FoPIA-2 workshops because: it enables the use of modern technologies in agriculture (including precision farming); it facilitates access on the market; it brings profit. Land consolidation for operation purposes is mainly characteristic for the plain areas of the case study region, while in the mountain areas the land consolidation process is much slower. Land consolidation appears to be essential for resilience capacities – the average size of farms in Nord Est region is 2.65 ha), which is very small in the European context (Romanian Farm Structure Survey, 2016). Introducing more technology is also essential for any agricultural development effort in the case-study area. Increasing farm size in combination with new technologies is assessed to positively contribute to all three resilience capacities.



2.4 Challenge 4: On-farm diversification and integration (trend)

As it resulted from the interviews and survey performed in the project, an important trend occurred at the level of small mixed farms is the niche-market orientation (introduction of new crops, niche crops, new/alternative species of animals - quails, ostriches) and on-farm multifunctionality development (direct processing of the farm's products, agro-tourism, handicrafts, services, etc.).

Diversification is seen as very important for the risk "dissipation", but there are limitations: this is about small farms: there is a limited number / types of activity that it can split into; there are territorial limitations (small acreage), and workforce limitations. Currently, the lack of available labor, and moreover, of skilled labor in the rural area is the most important limitation. Since these alternative crops and species are rather new in the agricultural landscape, and very few specialists are able to provide proper consultancy, availability of information is another boundary condition. The farmers should seek achieving a profitability threshold in order to be able to diversify, because diversification also means new technologies and new investment.

Diversification means also "closing the circuit"; as an example: not only growing vegetables and fruit; but also processing the products in various types of traditional products: canned jam, syrup, salads, in order to obtain products with higher value added. Farmers then sell these products either in the wet markets, or directly to clients. Promotion of these products is made through periodical fairs and exhibitions, by internet. Ideally would be to associate and make such sales in the association / cooperative's own shop. It is a good way to increase the added value of products and ensure their independence from various middlemen or sellers that impose to small producers all sorts of conditions.

Farms growing alternative crops have also good developing perspectives (for example sea buckthorn, berries, asparagus, etc.), they are very profitable, their products are in high demand either fresh, or with minimum processing (which is generally done on the farm premises, such as conditioning, packaging, freezing). Outlets include restaurants, cosmetic producers, and export markets.

Organic agriculture developed significantly in Romania after EU accession: number of organic operators increased 2.6 times (up to 9800), while the area under organic farming tripled (up to 395,000 ha) between 2007 and 2019. Organic production increased as well. Yet, there are several factors hindering the expansion of organic agriculture: high costs of certification, differences in certification rules in Romania and in other EU member states (unfavorable for Romanian organic farmers), undeveloped domestic markets (due to lower consumers' purchasing power). The certification rules depend on the national regulations imposed by the certification bodies in each



country, and for processed products they are more severe in Romania than in other member states. So, these tougher national regulations put the Romanian organic producers in a clear disadvantage as compared to foreign ones, prevents Romanian farmers to expand their organic production, to process the products and to supply domestic consumers with local organic products. The result is that most organic Romanian products are unprocessed and exported as such, while processed organic products on the Romanian markets are imported.

2.5 Challenge 5: Lack of available labour (trend)

There is an overall lack of available local labour – a challenge mentioned in all interviews, as well as in the AgriPolis focus group. Young people are not happy with relatively low farm incomes, and they move either to towns to find better paid out-of-farm employment, or they emigrate to work in Western countries. In many cases they do not quit completely the rural household and the agricultural activity: those who commute to towns are coming back and work part-time in the farms; those who emigrate are coming home for a couple of months almost every year to help their ageing parents working on the farm.

The lack of available labour seems to be a paradoxical phenomenon. Statistics indicate a high agricultural employment in the region: 51.2% (2000), 41.5% (2010), and the downward trend continued to 31.1% in 2018. During the transition period to a market economy (the '90-s), many industrial activities closed down, generating high urban unemployment. Combined with the land restitution which happened in the same period (as a result of dismantling the former agricultural cooperatives of the communist era), a reverse migration phenomenon occurred: workers from urban areas went back to rural areas, and agricultural employment increased again. Then, in the pre-accession years (2000-2006) and in the first 2 years of EU membership emigration (to Western countries) was strong (even if in many cases it was only a seasonal emigration), resulting again in a reduction in agricultural employment due to emigration. The post-crisis period (2009-2012) saw again a positive trend in agricultural employment, since many people previously employed in Western countries (in farming, construction, housekeeping, services) lost their jobs because of the economic crisis and were forced to return to Romania. Currently (2013- present), emigration occurred again, and agricultural employment in the case study area diminished again.

Focusing on labour issues, in the AgriPolis focus group workshop, participants agreed that the availability of unskilled labour is an issue concerning primarily the small farms from the case study region and availability of skilled labour force concerns, to a larger extent, the corporate/big farms from the region. Moreover, for the scarce skilled labour there is a competition between large farms, private inputs companies and government agencies involved in agriculture. The



consequences of the labour shortage noted by the participants were: impossibility to carry out the agricultural works in time, additional costs, production losses that led to the change of the regional agricultural structure (re-orientation to field crops requiring less labour, at the expense of animal husbandry which needs constant labour). The solutions converged to a greater financial motivation and the creation of a legal framework to foster the integration of unskilled labour force on the agricultural labour market. Concerning the skilled labour force, the main problem linked to its shortage resides in the fact that there is no correlation between formal professional training (from agricultural high-schools and universities) and the labour market requirements (such as high mechanization skills for modern equipment and managerial skills for running larger farms). During the discussion, it was pointed out that the agricultural vocational schools were disbanded, increasing the deficit on the agricultural labour market.

The immigrants from the Republic of Moldova participating in the seasonal farming activities in the NE region represent a partial solution to the crisis on the regional labour market. The advantages of hiring immigrants include stability of workers throughout the seasonal activity for which they were hired, because immigrants receive accommodation on the farm where they are hired and thus there is a low risk for these workers to leave for another farm, as it happens with the local people. More recently, especially for processing activities, small companies started hiring foreign workers coming from Asian countries. Currently, this is still difficult, due to complicated paperwork for non-EU personnel, and there are also issues related to the fact that people's mentality is still hindering the adoption of foreign people in the small communities. This mentality is very much biased based on the origin of foreign workers. There are no problems in accepting workers from Republic of Moldova, because they speak the same language, and have similar beliefs and traditions (historically, the largest share of Republic of Moldova used to be part of Romania).

2.6 Challenge 6: Change of agricultural policies / regulations (noise / cycle)

The rules and regulations (European and national) are changing too often – this is the main complaint of the farmers in this respect, as well as that the legislation is oriented mostly to the needs of large farms, and not of the small farms which are the vast majority. Currently, in the large farms, productivity is similar to the high levels in other Member States. Small farmers are generally having rather low productivity, but which could double in three-year time if the national and European policies would be more oriented to them. In this case, in a few years, small farms could become development poles in the rural areas.



The current agricultural and rural development policies are poorly targeted to small mixed farms; they are rather oriented to the development of medium-size farms, commercially oriented. Nevertheless, some policies targeted specifically to small farms are in place, but not enough to enabling a significant development. An important point is that many very small farms are excluded from direct payments because they have less than 1 ha, or plots less than 0.3 ha, or the minimum required number of animals. This is excluding about half of the total number of farms from direct payments or other types of financial support.

National regulations are changing too often, farmers can barely keep up with the changes, and that creates problems in filling in the applications and in receiving the subsidies, and this is perceived as a huge obstacle in activity.

The participants in workshops and interviews in the project expressed a major discontent with the fact that the Romanian authorities do not protect their own farmers. The example concerned eco-conditionality rules: the CAP proposed 11 different criteria to choose from to be imposed to farmers; Hungary chose only four of them, Poland also quite a few, while Romanian authorities chose them all to be fulfilled, thus disadvantaging its own farmers.

Current legislation provides poor support for organic agriculture, especially in terms of certification rules, which are considered much too severe; they are more severe than the corresponding rules in other MS, thus putting Romanian organic farmers in disadvantage as compared to their peers in EU. Participants in workshops in the project indicated that the current legislation is more hindering than stimulating for organic farming; it needs improvement.

The participants discussed also that simple, clear and favorable rules and regulations will help coping / responding to other challenges, such as fostering farmers' association, which are expected to set the ground for sales to supermarkets. If the supermarkets establish a good collaboration with the farming system through the associations, they may be interested to lobby to the decision makers for new rules and regulations favorable also to farmers. After that, stability of those regulations becomes of importance for all partners along the supply chain in establishing business plans and contracts, consolidating mutual trust and creating a good business environment.

2.7 Challenge 7: Price scissors (trend)

The permanent increase in agricultural input prices was mentioned by the participants in the survey and in the focus groups. This is in contrast to the general downward trend in agricultural prices. The declining trend in agricultural commodity prices on the domestic market is mainly due to competition from lower-priced imported agricultural products. The effect of this price scissors is to reduce the profitability of small farms which, due to their dimensional limitations and lack of cooperation, cannot achieve economies of scale.



3 RESPONSE ANALYSIS

In this section we present the response analysis for each specific challenge identified in Table 3. For each challenge the response analysis is reported in bullet points corresponding to:

1. Analysis of the possible **impact** on system functions
2. If and how the challenge has been **anticipated**
3. If and how the farming system has been able to **cope**
4. If and how the farming system has been able to **respond**

3.1 Challenge 1: Extreme weather conditions (noise)

3.1.1 Potential and actual impact on delivery of system functions

Extreme weather events such as droughts and floods, have increased in frequency and intensity. They have influence on several functions of the farming system. The most severe impact is on function 'food production', reducing its quantity and quality. Consequently, sales are lower, negatively affecting the function 'economic viability'. Although a lower supply might temporarily slightly increase the prices (for dairy products, meat, vegetables, fruit), the constant pressure of the imported products available in supermarkets prevents significant raises in prices in years of low domestic production.

Droughts are reducing significantly also the availability of feed and water for animals – resulting in a negative impact on function 'animal welfare'.

Floods affect farms in lower areas, as well as those in hilly areas, where forests have been cut on slopes. Most villages are located along rivers, and flooding of the family households increased in frequency, negatively affecting the function 'quality of life'.

3.1.2 Anticipation of the challenge *Extreme weather conditions*

In Romania, the problem of drought and its impact on the variability of agricultural production, farmers' incomes and food security is permanently present in the political, public and academic debate. There is a common understanding of the increasing severity and frequency of these extreme weather events. However, their appearance and amplitude is difficult to be anticipated.

3.1.3 Coping with the challenge *Extreme weather conditions*

Farmers are coping with this challenge in several ways. First, traditionally, by maintaining financial resources to be used during harsh times. In the recent years, changes in technology are applied: for crops, farmers started using new varieties – more resistant to drought and better adapted to local conditions. For animals, many small farmers are using local cattle races, which are less



productive, but also more resistant to heat and lower feed ratios, in contrast with commercial dairy farms which are using highly productive races, but for which productivity drops severely in case of reduced feed ratios. Also, where landscape conditions allowed, in time were created local reservoirs to ensure a minimum water supply for animals.

Small farmers avoid systematically to work with insurance companies (unless they are obliged to buy an insurance as a condition for obtaining funding for investments from the NRDP). Many past negative experiences, when farmers bought insurances from large insurance companies, incurred severe losses in case of disasters and were not reimbursed (under various unrealistic reasons) enhanced the lack of trust and reluctance to use this type of financial instrument.

Factors helping to cope with the challenge:

- Actors:
 - *farmers* knowledge about the characteristics of local/traditional varieties and animals resistant to the climate conditions.
 - *Insurance companies*: providing insurance forms/instruments tailored to the specific needs of small farms.
 - *Government* supports part of the farmers' losses caused by extreme weather events.
- Institutions:
 - *Special information / forecasts for farmers* provided by Weather National Authority
 - *Regulation from NRDP* regarding insurance for natural disaster linked with access to NRDP funding.
 - *Accountability* of governmental institutions on short-term impact alleviation.
- Resources:
 - *Farmers' financial savings*.
 - *Relief funds* (e.g., in 2020 the Government paid a financial aid to farmers which incurred losses in winter cereal crops, due to a severe drought in autumn, winter and spring).
 - *Support* (partial reimbursement) for insurance premiums for crops and animals.

3.1.4 Response to the challenge *Extreme weather conditions*

Due to the increased frequency and severity of droughts, the appropriate response is investment in irrigation equipment. Yet, such investments are still modest because the main irrigation network is poorly developed. Many Governmental programs were elaborated for rehabilitation or/and extending the primary irrigation network. Most of these programmes have remained in the proposal stage or have been underfunded.



Another response identified during interviews performed in the project was the partial replacement of traditional crops (wheat, maize) with alternative crops (Paulownia, spice crops, berries, hazelnuts, etc.), less demanding for humidity, and with better market opportunities.

Factors helping to respond to the challenge:

- Actors:
 - *Farmers* are setting “associations of water users”, to cooperate in investing in and using irrigation facilities.
 - *Consultants* and *researchers* are disseminating knowledge and new information among farmers regarding possible changes in technologies and about alternative crops and/or animals.
 - *Government* (National Rural Development Program - NRDP) that support irrigation systems development.
- Institutions:
 - *Consultancy* regarding technological changes.
 - *Accountability* of governmental institutions on long-term impact assessment and alleviation.
- Resources: funds accessible through projects under various sub-measures, aiming at:
 - buying and installing anti-hail nets in orchards.
 - investments for the development, modernizing or adapting the agricultural and forestry infrastructure – component irrigation infrastructure.
 - Support for investments regarding the restoration of agricultural land production potential affected by natural disasters, adverse environmental conditions and catastrophic events.

3.2 Challenge 2: Poor integration of small farms in agri-food chains (trend)

3.2.1 Potential and actual impact on delivery of system functions

The primary cause of the poor integration of small farms in agri-food chains is the general farmers’ reluctance to association. Functional associations/cooperatives play an essential role in buying the needed inputs for the member farmers, concentrate the supply and help finding markets for them. In the absence of such associative forms, the small farms’ supply varies largely in terms of quantity, quality, and diversity of products, faces incertitude of sales and price fluctuations. On the other end of the chain, processor and retailers do not buy products from local small producers unless they are organized, and the supply is more concentrated. Instead, they prefer to import similar products; so, an important impact is the partial loss of domestic urban markets by the local producers.



Thus, the poor integration of small farms in agri-food chains translates in a poor planning and predictability of production and sales of the small farms, with negative impact upon system functions 'food production' and 'economic viability', and, consequently, on 'attractiveness of the area'.

Development of cooperatives will be able to generate an increase in the 'quality of life' and 'attractiveness of rural areas' through the additional non-agricultural jobs and incomes associated with the services developed when the increase of the market integration of primary agricultural production will occur.

3.2.2 Anticipation of the challenge *Poor integration of small farms in agri-food chains*

The poor integration of small farms in agri-food chains due to lack of association/cooperation is a long term (old and continuous) challenge, everybody talks about it. Despite the efforts of policy makers and authorities (information/dissemination caravans, various measures aiming at stimulating associations), the results are still modest.

The pre-accession programme SAPARD was the first programme that tried to stimulate small farmers to form producer groups or cooperatives. It was continued after accession by various measures funded from the NRDP. Most of the cooperatives formed did not survive more than a few years, for various reasons: lack of trust, inadequate legislation, unclear and contradictory regulations, poor management, late payments or non-fulfillment of contracts by milk processors or slaughterhouses, etc. Still, but at a quite low pace, different forms of farmers' associations or cooperatives continue to emerge, mostly where the farmers acknowledged the economic and managerial advantages in terms of selling their products or accessing funding specifically targeted to producer groups or cooperatives. Very few cooperatives are successful, and their success is based mostly on their ability to sell the products with a positive involvement of processors or of retailers. Although farmers' reluctance to cooperate / associate is recognized, this was not properly studied, nor addressed. So, up to now, effective mechanisms to deal with this attitude have not yet been found. Thus, anticipation did not help much to alleviate the potential and actual impact.

3.2.3 Coping with the challenge *Poor integration of small farms in agri-food chains*

There are several ways to cope with this challenge. When prices paid by processors or retailers became too low, farmers reoriented themselves to local markets (both rural and urban). They also started short supply chains, by direct sales through customer lists. They also created web pages for on-sales. These coping actions also involved a change of roles among the household (family) members: one or several members of the family diminished their participation in the direct



production activities and became involved in direct sales activities: transport and sale of products to wet markets or direct customers.

An opposite form of coping (mostly in case of ageing farmers or distant markets) was a reduction of their business: limiting production to cover on-farm consumption and local sales.

Factors helping to cope with the challenge:

- Actors:
 - *Farmers* are reorienting to local markets and short supply chains; they are gathering information from all possible sources.
 - *Consultants* and *NGO's* are helping small farmers to find and enter local markets.
 - *Local authorities* are organizing special fairs to help small farmers to connect with potential customers and promote their products.
- Institutions:
 - *Consultancy and advice* from experts.
 - Alternative (local) *markets*.
- Resources: extra costs for farmers when involved in direct sales (logistics and transport of products to wet markets or direct customers).

3.2.4 Response to the challenge *Poor integration of small farms in agri-food chains*

Although the National Rural Development Programme (NRDP) includes measures aiming at stimulating association, and despite the continuous efforts of the public consultants, farmers are still extremely reluctant to association / cooperation. Nevertheless, some farmers, mostly young ones and those who used to work abroad in farming started setting small associations/cooperatives. In many cases, the Local Action Groups were also involved and helped the new associations to access funding through support measures in NRDP, e.g., for investing in milk tanks or in storage facilities for vegetables and fruit. Thus, by concentrating supply, it was easier to make contracts for milk deliveries to processors or for vegetable and fruit sales to processing units or retailers.

Factors helping to respond to the challenge:

- Actors:
 - *Farmers* are adapting or changing their production structure to better respond to the demand on local markets, or, in case of associations, to the demand of processors and/or retailers (variety and quality of products, conditioning and packaging, sanitary norms, etc.).
 - Several *supermarket chains* initiated special programs for associations, by encouraging the farmers to collect and package their products and helping the farmers to create the



necessary logistics for their deliveries. For the moment, this is feasible in the Nord-Est region only by Carrefour who has a local warehouse; all other retail chains have very few large warehouses located very far away (at least 300 km away). Recently, Kaufland initiated a program for helping also individual small farmers to sell vegetables and fruit in their network.

- Institutions:
 - *NRDP*' incentives supporting cooperation among farmers.
 - *Local Action Groups (LAG)*: helping new associations to access funding through support measures in NRDP.
 - *National regulation* aiming at including a specific quota (51%) for the national products into supermarkets.
- Resources: funds accessible through projects under sub-measures of the NRDP for:
 - *Support* for horizontal and vertical cooperation between actors in the supply chain in the agricultural and fruit sectors.
 - *Investment* in milk collection equipment.
 - *Investment* in storage facilities (for vegetables and fruit).
 - *Investment* in small size slaughterhouses in mountain areas.
 - *Supermarkets' investments / programs* on cooperative establishing among local farmers to provide 51% Romanian products on their shelves.

3.3 Challenge 3: Business development

3.3.1 Potential and actual impact on delivery of system functions

Land consolidation is achieved by small farms through leasing and purchasing land. It aims, besides facilitating productivity gains, opposing the fragmentation trend due to succession rules. The technological and managerial improvements have positive effects on system functions 'food production', 'bio-based resources', and 'economic viability'. On the other hand, farmers that manage to expand their business and change their farms from small farms into more specialized commercial ones would require important changes in technology for intensification. That would imply an increased use of fertilizers, pesticides, and water, which would negatively affect functions 'natural resources' and 'biodiversity & habitat'.

'Animal health and welfare' function is positively influenced by investments in animal farms; projects under NRDP either to start a new farm or to enlarge / modernize an existing one, impose a set of requirements in this respect.



In time, with local development, more businesses are expected to emerge, thus increasing the 'attractivity of rural areas', favored also by the fact that they have less bureaucratic requirements than the businesses located in urban areas.

3.3.2 Anticipation of the challenge *Business development*

Closing the technological gap was seen as a continuous need since the '90-s. Various policies (funded from the budget of the Ministry of Agriculture and Rural Development) were designed to foster that before EU accession, but with limited funds and effects.

The pre-accession programme SAPARD was the first programme (with EU funding) that started helping small farmers to develop their farming business. It was continued after EU accession by various measures funded from the NRDP.

3.3.3 Coping with the challenge *Business development*

Generally, technological improvements require funding and knowledge. Farmers are coping with this challenge in several ways. First, traditionally, by using private financial resources (their own or of the extended family). In the interviews performed in the project, most farmers indicated savings (from non-farming jobs / activities and from family members) as main source for financing the farm investments.

The commercial banks are reluctant to work with small farmers (low profit margins, no bank branches in rural areas, no financial instruments tailored for the needs and possibilities of small farms, etc.). Banking and credit activity are very strictly regulated in terms of conditions and collaterals, which makes small farmers' access to it almost impossible. Currently, it is easier for the small farmers to access funding from "non-banking financial institutions" which provide credits with far less collaterals, but the amounts are rather small, and the interest rates are higher than for bank credits.

Factors helping to cope with the challenge:

- Actors:
 - *Farmers* are gathering information from all possible sources; the main sources are Internet, specialized media, consultants. They also apply knowledge and skills acquired while working abroad.
 - *Experts* providing support for a proper implementation of technology.
 - *Other farmer'* experiences.
 - *Government*: providing support for (re)technologization of farms.
- Institutions:

- *Vocational training in agriculture* for obtaining of trained agricultural producer certificate as a precondition for applying for funding projects through NRDP.
- *Trusted farmer network of influence.*
- Resources:
 - *Funds accessible through projects* under measures of the NRDP for:
 - modernizing technologies in crop and animal farms.
 - support for small farms to shift from semi-subsistence farms to small-medium farms commercially oriented.
 - *Farmer's and extended farmer's family savings.*
 - *Non-banking* financial institutions.

3.3.4 Response to the challenge *Business development*

Successful responses to this challenge depend on the willingness of the farmers to adopt changes, to shift to new technologies and seek the information on how to do it, to find guidance from advisers / consultants and receive support from the banking-financial system and from the public administration.

The basic response is about giving small farmers access to information regarding the new (innovative) technologies and funding for investment in business development. There is a high need for development of banking-financial networks which should spatially cover the rural areas, and for introduction of new financial instruments, adapted to the small farmers needs and activity, which should keep in mind the timetable and seasonality of the financial flows specific for to the agricultural activities.

Factors helping to respond to the challenge:

- Actors:
 - *Farmers* accepting the need for changes and having a proactive role in looking and getting the information they need.
 - *Consultants, input suppliers, innovation developers* are disseminating information and knowledge through specialized fairs, presentation days, and organizing demonstrative farms to promote new technologies.
 - *Banks and government* acting together for facilitating the access of small farmers to loans.
- Institutions:
 - *NRDP regulation principle* regarding the novelty of the technological acquisitions.
 - *Training and technological support* for novel technologies use provided by machinery's sellers and innovative technology providers.
 - *Consultants (public advisers)* should be properly qualified and well informed on the subjects, to be able to assist the farmers. Farmers also expect public consultants to help



them to prepare projects for accessing funding through NRDP, because for small farmers it is too costly to hire private consultants.

- *Government/ public administration* major role is to continuously improve the legislation, the regulations, the fiscal policy; to ensure the proper functioning of the Agricultural Chambers and to facilitate the small farmers' access to funding through the banking system.
- *Schools and universities*: developing new curricula, adapted to current developing trends in modern agriculture (precision agriculture, high productivity technologies, use of modern machinery, principles of bioeconomy, etc.).
- Resources:
 - *Funds accessible through projects under the NRDP* for
 - Innovative technology acquisition.
 - Support for small farms to shift from semi-subsistence farms to small-medium farms with commercially oriented.
 - *Banks*: loans for co-financing the NRDP projects, accessible for the small farms.
 - *Public guaranteed funds* for small farm loans are necessary in order to facilitate their access to banking system.

3.4 Challenge 4: On-farm diversification and integration

3.4.1 Potential and actual impact on delivery of system functions

The introduction of activities linked to agricultural production such as new / niche crops, or alternative species of animals is basically aimed at increasing sales and profits by occupying market segments different from the majority of farmers performing traditional agricultural activities, thus having positive impact on delivery of private goods through system functions 'economic viability', 'bio-based resources (sales)' and 'food production'. It also has a positive impact on function 'biodiversity & habitat'. To this impact also contributes the fact that in some cases, development of such farms is possible in areas less favorable (or improper) for common crops and livestock (high hills, semi-forest and mountain areas, etc.).

Conversion to organic agriculture, although long and costly, and further organic production is expected in the medium-term to increase income from sales at higher prices, with positive impact on functions 'economic viability', 'biodiversity & habitat' and 'animal health and welfare' (for organic animal farms).



The most frequent response to the need of diversification among the farmers interviewed in the project was involvement in the direct processing of the farm's products. By increasing the added value of farm products and selling them directly, the impact is positive for functions 'economic viability' and bio-based resources'.

Involvement in non-agricultural activities (agri-tourism, handicrafts, services, etc.), although it requires specific training, knowledge and skills, as well as funding (or important investments in case of agri-touristic activities), has positive effects on functions 'economic viability', 'quality of life' and 'attractiveness of the area'.

3.4.2 Anticipation of the challenge *On-farm diversification and integration*

Initially taken into consideration by farmers with more entrepreneurial abilities, diversification of activities and income sources at farm level was seen as an increasing need mostly since the pre-accession period. Various policies (funded from the budget of the Ministry of Agriculture and Rural Development) were designed to foster that before EU accession, but with limited funds and effects.

3.4.3 Coping with the challenge *On-farm diversification and integration*

The coping mechanisms for this challenge are basically linked to actions of looking for information on market demand, existing market niches, existing quality schemes compatible with the agro-food farm' products.

A second coping mechanism is linked to acquiring new knowledge and skills through education and training. This becomes essential for success if involving in integration with non-agricultural activities (agro-tourism, handicrafts, services, etc.).

Factors helping to cope with the challenge:

- Actors:
 - *Farmers* are gathering information from all possible sources; the main sources are Internet, specialized media.
 - *Consultants* and *researchers* are providing information and knowledge on the quality schemes and new / niche / alternative crops and animals technologies. They also have an important role in terms of providing good practices examples, technological, economic and financial consultancy on diversification.
 - *Certification bodies for national quality schemes (traditional agri-food products)*.
- Institutions:

- *Specific quality schemes* (traditional products, mountain product, TSG - Traditional Specialty Guaranteed) represents a good way to access the niche markets for the existing farm products.
- *General public* increasing interest for traditional agri-food products and for agri-tourism.
- Resources: funds accessible through projects under sub-measures of the NRDP.

3.4.4 Response to the challenge *On-farm diversification and integration*

A precondition would be the farmers' availability and willingness to diversify. Then, the farmers need to accept such a modern vision, to look for information and solutions.

In most cases, diversification requires funding for introduction of new / niche crops. New / alternative species of animals require investment for building appropriate shelters and buying the animals. Investments are needed also for processing farm products: appropriate spaces (or buildings), specific machinery and equipment, all complying with rules and regulations regarding hygiene and food safety.

Diversification by involvement in agri-touristic activities requires again major investment and proper knowledge on all specific regulations.

Factors helping to respond to the challenge:

- Actors:
 - *Farmers* accepting the need for changes and having a proactive role in looking and getting the information they need.
 - *Associations and LAG-s*: they can play an important role in promoting diversification, to be facilitators, to provide solutions and support.
- Institutions:
 - The *banking-financial system* plays an important role in the access to funding of farmers or farmers' associations with initiatives in diversification, in offering facilities for diversified farmers that either entered in vertical integration or diversified the farming operations.
 - *government/ public administration* major role is to provide support through an adequate legislation.
 - The *research-development sector* has an important role in small farms diversification, by developing new products, and by providing new ideas and solutions in: products processing, services, handicrafts, agro-tourism and other non-agricultural activities.
- Resources: funds accessible through projects under sub-measures of the NRDP for:
 - *Support* for conversion to organic farming and for maintaining organic farming practices.
 - *Setting up and development* of non-agricultural activities in rural areas (agri-touristic activities).



- *Support* for increasing the added value of agricultural products, promoting short supply chains in local markets.
- *Support* for establishment and development of small businesses and job creation.

3.5 Challenge 5: Lack of available labour

3.5.1 Potential and actual impact on delivery of system functions

The potential impact on main system functions would be negative for ‘food production’ and ‘bio-based resources’ (less production and lower sales in terms of quantity, quality, and diversity) and ‘economic viability’ since lack of available labour diminishes the potential for farm (mostly animal farms) development and also implies higher labour costs.

Rural life relies on small farms, because this is the real landscape, because the Romanian village means small households, which are essentially and mostly small mixed farms. In absence of local / community development (villages remained populated by old persons and sometimes also by young children left behind in their care, while parents are working abroad), function ‘attractiveness of area’ is also negatively influenced.

The actual impact of lack of available labour is negative on the same three functions - ‘food production’, ‘bio-based resources’ and ‘economic viability’ due to low production of labor-intensive farming activities (animal husbandry and horticulture).

Many small (subsistence and semi-subsistence farms) are prevented from concentration and development by a generation of old farmers that value land as their most dear asset (irrespective of its profitability) and only their disappearance in time will make room for successors that are willing to develop their farm and consider land as an economic asset, not a spiritual one to be kept at any costs. There is another phenomenon linked to succession rules: the farm (especially the land) is legally split in the next generation (which generally is formed by several children), making even more difficult the efforts directed to land consolidation as a basis for increasing the physical and economic size of the farms.

There is already a potential future succession problem in many farms run by old farmers: their children left and do not intend to return and take over the farm, since they already made a living for themselves and their families out of the rural areas or even out of the country. And (as some demography interviews revealed), some farmers that are currently in activity (aged 35-50 years) are encouraging their children to choose non-agricultural professions, so the young generation to be able to have higher incomes from other economic activities and enjoy a higher quality of life in urban areas.



The low profitability of small-scale agriculture makes this activity unattractive for potential successors, which are looking for better occupational alternatives in urban areas or abroad. The migration of the young rural population (which, in general, has a higher level of education) generates a deficit in the labor market that, implicitly, translates into an increase of labor costs in the farm system, negatively affecting the function 'economic viability'.

3.5.2 Anticipation of the challenge *Lack of available labour*

Since it is a long-term trend, the challenge was anticipated and is well known in the farming system. The measure put in place in anticipation (already in the pre-accession period) was the early retirement scheme, but due low funding and poor design and management, it did not have the expected results (low participation of old farmers).

In academic and political debates this subject it is discussed in terms of underemployment of the rural population in Romanian agriculture. The high social pressure on land resources from the rural population is an important obstacle to land concentration and to increased market orientation of small farms, thus questioning their economic viability. In this context, the migration of the rural population was perceived as a positive trend. What was not correctly anticipated was the departure of most of those able to work from the countryside and the fact that most of the remaining ones are old and unable to work in agriculture.

3.5.3 Coping with the challenge *Lack of available labour*

The negative potential impact on 'food production' and 'bio-based resources (sales)' did not occur in the case of field crops (where it was compensated by mechanization), but it occurred in the case of animal husbandry and horticultural products requiring intensive and permanent labour. In time, the ageing small farmers reduced the animal production activity down to minimum possible (for the needs of feeding the family only) or just abandoned it. In interviews performed in the project, farmers pointed out the massive reduction of animal numbers, especially in rural areas close to large municipalities.

Reducing or exiting farming activities in peri-urban villages was stimulated also by land-grabbing (purchase of all available land for sale by very large agricultural holdings or by large retailer chains), as well as by the high demand for land used for house building (development of urban areas and of secondary residences). People living in towns are buying land and houses to move to when they retire, small entrepreneurs in services, etc. The problem of rural population diminishment is harder in remote areas, people are migrating to urban areas or abroad. One participant pointed out that for a few years, there were some subsidies provided to farms or processing units to support the mobility of workers hired by farms, processing units or building sites. So, people were coming to work from areas located 50-60 km away. Currently, such



subsidies ceased and in order to keep their workers, farmers and entrepreneurs are paying for transportation (as a bonus to the monthly wage), or they bought minibuses and are organizing daily transportation for the workers. In one LAG, a large farmer does that, and even provides accommodation for workers coming from more distant villages. As consequence, those workers do not farm their land (back home) anymore, they just rent it.

Factors helping to cope with the challenge:

- Actors:
 - *Farmers*: Work harder and involve the help of all family members to compensate the lack of available labour or are investing in mechanization. Diminish or abandon the labour intensive activities in the farm.
 - *Government*: issued more strict regulations on seasonal and daily labour aiming at diminishing black labour and provide workers with social and medical insurances.
- Institutions:
 - *National regulation regarding social security benefits*: since 2011, the amplification of social support had negative impact on available labour. Criteria for getting social support are rather large, and many persons in working group age and able to work prefer to reside on social support (which is a very low but regular income) rather than be seasonal or daily workers. This is seen by farmers as a serious disincentive to work. A revision of the criteria for obtaining social support is needed, so beneficiaries should remain those persons in real need of such support. The remaining funds could be better used in actions aimed at local development of the community.
- Resources: funds accessible through projects under sub-measures of the NRDP for:
 - *Support* for investment in farm equipment and machinery (to replace labour).

3.5.4 Response to the challenge *Lack of available labour*

Changes in the farming system related to the challenge are more related to coping rather than responding.

Factors helping to respond to the challenge:

- Actors:
 - *Young (potential) farmers* with changed mentalities: they see the farm as an economic asset, as a business, and manage it as a business, as opposed to old farmers that value land as their most dear asset, a family heirloom, and a token of social position in the community (irrespectively of its profitability).
- Institutions:
 - *Government*: actions aiming at reversing demographic trends.



- *Rules for Retirement scheme for old farmers and Young farmers installation scheme from the NRDP.* A revision of the retirement scheme is needed, better designed and funded in order to be attractive for both retiring and new farmers.
- *"Diaspora start-up" - Rules for funding the return of workers abroad for business development* was launched late (2017) and not succeeded to reverse the demographic trends because it was not accompanied by other measures supporting the (farm) business environment development.
- Resources: funds accessible through projects under NRDP and other governmental schemes for:
 - *Support* for installation of young farmers
 - *Support* for early retirement scheme.
 - *Support* for new farms started by young farmers that returned from abroad (where they worked at least 3 months in farming or graduated agricultural related education programs)
 - *Support* of business start-up by Romanians that return from working abroad.

3.6 Challenge 6: Change of agricultural policies / regulations (noise / cycle)

3.6.1 Potential and actual impact on delivery of system functions

The Common Agricultural Policy with its complex system of rules and regulations has potential impact on the delivery of all functions of the farming system. Changes in this system may have positive impact only if they make the rules and their implementation process less complicated, less bureaucratic, and less subject to non-objective evaluation and corruption.

Standards and quality requirements have potential impact on functions 'food production' and 'bio-based resources' by setting quality thresholds that cannot be always fulfilled by small farms, thus excluding them from export markets.

Direct payments, subsidies, and funding through NRDP measures are having an essential positive impact on 'economic viability', since they are covering important parts of production costs but also providing the financial possibility for business development through technical improvement and investments.

Measures from NRDP and their eligibility conditions for supporting rural communities have a potential positive impact on functions 'quality of life' and 'attractivity of rural areas'.

Conditionalities for CAP support, environmental requirements, LFA and organic agriculture regulations have a potential impact on functions 'natural resources and 'biodiversity & habitat'.



Finally, cross-compliance requirements and all regulations on animal husbandry have a positive influence on function 'animal health and welfare'.

Nevertheless, poor understanding of CAP policies and regulations and excessively tough implementation rules at national level are creating serious disadvantages for Romanian farmers which must compete on both international and domestic markets with products coming from other member states farming systems, much better supported by their national legislation.

Interviews and workshops showed that frequent changes of policies, measures, regulations, norms, implementation rules, for getting support are heavily affecting the capacity of small farms to quickly adapt and continue obtaining various types of support available through CAP or through specific national policies and programs.

3.6.2 Anticipation of the challenge *Change of agricultural policies / regulations*

It is possible because new policies and rules are publicly debated way before their implementation, so farmers are able to anticipate potential unwanted impacts and suggest changes adequate for their needs. Essential regulations change cyclically (every seven years), together with the start of the new programming (budgetary) periods of CAP. Things are more complicated at national level, since changes are far more frequent.

Factors helping to anticipate the challenge:

- *Actors: farmers and farmers' associations* are debating in public consultation and by adequate lobbying the new measures or the changes in the existing ones. Their role is to point out flaws and potential difficulties in implementation and fight for simpler and clearer regulations.
- *Institutions: consultants, Ministry of Agriculture and Rural Development and all its agencies* are analyzing the actual difficulties and problems in implementation of the current policies and based on knowledge of the national farming are evaluating and forecasting potential problems that might occur in the future and suggest corrections where necessary.
- *Resources: knowledge building, learning and communication between policy makers, implementation agencies and beneficiaries.*

3.6.3 Coping with the challenge *Change of agricultural policies / regulations*

The main coping mechanism is learning by doing. All parties involved are interested in a successful implementation of the policies and regulations.

Factors helping to cope with the challenge:

- *Actors: farmers* are learning which support measures are better adapted to their needs and how to adapt to changes.
- *Institutions:*

- *Consultants and implementing agencies* collaborate with farmers to help them knowing and dealing with changes in policies and regulations. They also have an important role in collecting and evaluating comments and complaints from farmers that encountered problems, unexpected obstacles and inconsistencies in definition or implementation of new policies and regulations.
- *Ministry of Agriculture and Rural Development (MARD) and other policy makers* are using all that information to evaluate which measures have most favorable impact in the national farming systems, which measures do not work and correct the amount of funding, the eligibility and implementation rules of the measures.
- Resources: monitoring committees, organizing workshop, debates, forums for facilitating communication between all the involved parties - from policy makers to direct beneficiaries.

3.6.4 Response to the challenge *Change of agricultural policies / regulations*

The farming system responded to the challenge by rapid endorsement of changes and developing towards alternative systems, better adapted to the constantly changing environment and more economically viable.

The absorption of funds available through CAP increased significantly from the time of EU accession (2007) to present time. The main result is a gradual transformation of the studied farming system (small mixed farms) into a system more efficient, better inserted in value chains, and which is making efforts to fulfill its main economic, social and environmental functions.

Factors helping to respond to the challenge:

- Actors: *farmers* are increasingly accessing and using available funds, while struggling to permanently adapt to changes in policies and regulations, to understand, learn and use them properly. Yet, there is a certain amount of frustration due to these changes that they perceive as much too frequent, poorly adapted to the needs of small farms and quite discriminatory as compared to national regulations implemented in other member states.
- Institutions:
 - There is a major need for *administration and implementing agencies* to improve their human capital, their knowledge and skills in implementation of the NRDP measures, in laws and regulations interpretation. They should aim at being perceived by farmers as honest collaborative partners and not enemies.
 - *MARD and other policy makers* need to take the appropriate actions to make EU and national regulations compatible and eliminate all sources of mismatching and conflictual legal provisions.
- Resources: knowledge building, learning and communication between policy makers, implementation agencies and beneficiaries.



3.7 Challenge 7: Price scissors

3.7.1 Potential and actual impact on delivery of system functions

The permanent decline in income from the sale of agricultural products (generated by falling agricultural prices) restricts the access of small farms to the input market (whose prices are continuously rising). Limiting the use of agricultural inputs leads to a decrease in agricultural yields, which results in higher costs per unit of product. This creates a spiral effect through which the 'economic viability' of small mixed farms is called into question. Therefore, the continuation of the farm business in the long-term is negatively affected, as well as income levels in rural areas, diminishing the 'attractiveness of the area'. The ability of farms to 'deliver healthy and affordable food products' is also negatively affected.

3.7.2 Anticipation of the challenge *Price scissors*

The challenge represented by the price scissors in agriculture has been present in the public debate in Romania in the last three decades. In the pre-accession period, but mostly after accession, due to the removal of barriers to the import of agri-food products from EU countries, the public debate focused on the poor productive performance of Romanian small farms in Romania which makes them uncompetitive as compared to their foreign competitors. The decline in prices of agricultural products has contributed, in many cases, to the farmers' "herd-type" behavior regarding the product mix cultivated in their farm. Thus, if in a certain year the price of a given agricultural product "A" was higher, and the price of product "B" low or normal, the next year, hoping for a significant gain, many farmers cultivated the product "A" on much larger areas, to the expense of areas allocated for product "B". The excess supply thus created for product "A" resulted in its price decrease, and the expected income raise not happening. On the other hand, the deficit in supply created for product "B" resulted in its price increase. Farmers did not learn much from these experiences and repeated them in a spiral. A reliable market information system and production planning would help avoiding such behavior in the future.

3.7.3 Coping with the challenge *Price scissors*

Very small (subsistence) farms, which poor links with the markets, are less vulnerable to the opening of price scissors because they use relatively few inputs from the market and sell only small surpluses of what they produce. The rest of the small mixed farms are significantly exposed to this risk because they are not organized in associations and cooperatives through which they would be able to negotiate the prices of their inputs and of their products on the market. Therefore, they can hardly cope with this price scissors.

Factors helping to cope with the challenge:

- Actors:



- *Farmers* – poor ability of small farmers to anticipate market evolutions; they are likely to make decisions based on unrealistic expectations.
- *Government intervention on agricultural and input prices (before EU accession).*
- *EU intervention* (through CAP policy after EU accession).
- *MARD* – managing agricultural policies.
- *Payment agencies* (APIA, AFIR).
- Institutions:
 - *Farmer's* intention to speculate on market trends.
 - *Regulations* for basic agricultural product prices.
 - *Regulations* for subsidizing agricultural inputs.
 - *CAP support (subsidies)* - cover part of production costs and support farmers' income.
 - *Agricultural market information system* (price monitoring system on regional basis managed by the MARD).

Resources:

- *National funds (from MADR budget)* supporting the regulated prices for basic agri-food products (before EU accession).
- *Subsidies* for agricultural inputs (before EU accession).
- *CAP payments* (after accession).

3.7.4 Response to the challenge *Price scissors*

Often small farms face the problem of low profitability or losses generated by negative input-output balances. The answer to this challenge is, moreover, an individual one, assumed by each farmer. The answers, however, have a certain pattern: farmers are looking for uncovered market niches to which they re-orient their production structures. They invest in these innovative changes using European funds (projects) or from their own savings. The change is not a radical one, but a gradual one and starts with the initial documentation on the market potential and the necessary technological change. Media sources are most often used for documentation and are followed by an attempt to transform a part of the farm only. If the results are positive, extended implementation of the change follows.

Farmers are also looking for new, less expensive technologies and inputs to restore the farm's economic viability.

Many small farmers do not have the ability to look for answers to this challenge. The current (public) consulting (advisory) system is dysfunctional, and generally not connected to individual farms unless they implement projects funded by European funds, for which consultants provide technical support for a fee. The lack of associative forms also makes the small farm system vulnerable because there is no system providing structured information and supporting system



actors in finding viable solutions to respond to the price scissors challenge. So, for some farmers the only possible is exiting farming activities.

Factors helping to respond to the challenge:

- Actors:
 - *Farmers* – searching for new uncovered market niches (not covered by other farmers or by imported products).
 - *Input and innovations providers* - which develop less expensive and higher yielding technologies.
 - *Media* – providing innovative ideas and good practice models for potential changes at the farm level and, also, market information.
 - *R&D actors* which inform famers and media about innovative solutions developed by them.
- Institutions:
 - *CAP incentives* supporting innovation adoption.
- Resources:
 - *Farmers' own funds*.
 - *Funds accessible* through projects under NRDP.
 - *Information* from media sources (internet, TV, radio).



4 PATTERN ANALYSIS

4.1 Patterns across system functions

A pattern that can be identified is that all challenges have an impact on both private and public functions of the system. As expected, the most affected private functions are ‘food production’, Bio-based resources (sales)’ and ‘economic viability’, while among the public functions, ‘attractiveness of the area’ seems the most impacted. Table 3 shows different patterns of challenges affecting the small mixed farming system functions.

Table 3. Challenge impact upon the small mixed farming system functions in Nord-Est region of Romania

Challenge	System functions							
	Private goods				Public goods			
	Food production	Bio-based resources (product sales)	Economic viability	Quality of life	Natural resources	Biodiversity & habitat	Attractiveness of the area	Animal health & welfare
1 – Extreme weather conditions	-	-	-	-				-
2 – Poor integration of small farms in agri-food chains	-	-	-				-	
3 – Business development	+	+	+		-	-	+	+
4 – On-farm diversification and integration	+	+	+	+		+	+	+
5 – Lack of available labour	-	-	-				-	
6 – Change of agricultural policies and regulations	-	-	+	+	+	+	+	+
7 – Price scissors	-	-	-				-	

4.2 Patterns in capacity of anticipating effects

In general, whatever the challenge, the small mixed farm system in the Nord-Est region shows a poor capacity to anticipate the effects, in three forms:

- underestimation of the impact - occurs when the effects are incorrectly identified - as in the case of *business development* challenge (which has made vulnerable more specialized farms to competition from imported products);
- misidentification of the effects - as in the case of *lack of available labour challenge*: the effects of external migration of the rural population was initially expected to be positive (on underemployment of the large rural population, on its pressure on land resources as an obstacle to land concentration into larger and more efficient farms), but it turned out to be detrimental, due to massive (e)migration of persons in the active working age group that resulted in a lack of actual labor availability for domestic agriculture;
- focusing on the most obvious effects and ignoring others, considered secondary - as in the case of *poor integration of small farms in agri-food chains challenge*: it was seen as having implications on farmers' incomes (and economic viability of farms), but ignored the effect that the association and cooperation between farmers could have on access to knowledge and innovation as well as on improving their bargaining power in relation with other actors in the value chain and also in the political dialogue.

Table 4. Anticipation of challenges by the small mixed farming system

Challenge	Characterization
1 – Extreme weather conditions	<ul style="list-style-type: none"> - Difficult - Need for irrigation is well known; lack of investment funds
2 – Poor integration of small farms in agri-food chains	<ul style="list-style-type: none"> - Reluctance to association / cooperation - SAPARD - Inefficient fostering measures
3 – Business development	<ul style="list-style-type: none"> - SAPARD - Limited funds and effects in the pre-accession period
4 – On-farm diversification and integration	<ul style="list-style-type: none"> - Anticipated by farmers with entrepreneurial abilities
5 – Lack of available labour	<ul style="list-style-type: none"> - Early retirement scheme – low funding, poor design and management - Not correctly anticipated: departure of most young able workers; most of the remaining people are old and unable to work in agriculture
6 – Change of agricultural policies and regulations	<ul style="list-style-type: none"> - Farmers and farmers' associations are debating in public consultation and through appropriate lobbying new measures or needed changes to the existing ones

Challenge	Characterization
	- the consultants, MARD and all its agencies are analyzing the real difficulties and problems in the implementation of current policies and based on the knowledge of the particularities of national agriculture, assess and anticipate potential problems
7 – Price scissors	- Present in Romanian agriculture in the last three decades



Table 5. Coping with challenges - synthesis

Challenge	Actors	Institutions	Resources
1 – Extreme weather conditions	Farmers: <ul style="list-style-type: none"> - Technological changes (resistant crop varieties / animal races) Insurance companies: <ul style="list-style-type: none"> - Providing instruments tailored to the specific needs of small farms Government: <ul style="list-style-type: none"> - Supports part of farmer's losses 	National Weather Authority: <ul style="list-style-type: none"> - Special information and forecasts for farmers NRDP: <ul style="list-style-type: none"> - Mandatory insurances as a condition for access to NRDP funding Government: <ul style="list-style-type: none"> - Accountability on short-term impact alleviation 	Farmers: <ul style="list-style-type: none"> - Own financial savings Government: <ul style="list-style-type: none"> - Relief funds - Partial reimbursement of insurance premiums for crops and animals
2 – Poor integration of small farms in agri-food chains	Farmers: <ul style="list-style-type: none"> - Reorienting to short supply chains or direct sales Consultants / NGO-s: <ul style="list-style-type: none"> - Helping farmers to find and enter local markets Local authorities: <ul style="list-style-type: none"> - Organizing special fairs to help small farmers to promote and sell their products 	Consultants: <ul style="list-style-type: none"> - Dissemination of advice and information Alternative local markets	Farmers: <ul style="list-style-type: none"> - Own resources - Extra costs for farmers when involved in direct sales
3 – Business development	Farmers: <ul style="list-style-type: none"> - Gathering information from all available sources - Knowledge acquired while working abroad - Other farmers' experience Experts: <ul style="list-style-type: none"> - Providing proper support for proper implementation of technology Government: <ul style="list-style-type: none"> - providing support for (re)technologization of farms 	Educational institutions: <ul style="list-style-type: none"> - Vocational training in agriculture for obtaining certificates (condition for applying for NRDP funded projects) Farmers' networks of influence	Farmers: <ul style="list-style-type: none"> - Farmer's and extended family's savings - Finanțare de la întreprinderi financiare ne-bancare NRDP: <ul style="list-style-type: none"> - Modernizing technologies in crop and animal farms Non-banking financial institutions



Challenge	Actors	Institutions	Resources
4 – On-farm diversification and integration	Farmers: <ul style="list-style-type: none"> - Gathering information from all available sources Consultants: <ul style="list-style-type: none"> - Providing information and knowledge on quality schemes and new / niche / alternative crops and animal technologies Certification bodies: <ul style="list-style-type: none"> - For national quality schemes (traditional products) 	Specific quality schemes: <ul style="list-style-type: none"> - TSG, mountain product, traditional product = ways to access niche markets for existing farm products General public: <ul style="list-style-type: none"> - Increasing interest for traditional agri-food products and agri-tourism 	NRDP: <ul style="list-style-type: none"> - Funds accessible through projects
5 – Lack of available labour	Farmers: <ul style="list-style-type: none"> - Work harder - Involve all family members to compensate for the lack of available labour - Investing in mechanization - Diminish abandon labour intensive activities in the farm Government: <ul style="list-style-type: none"> - More strict regulations on seasonal and daily labour 	Government / local authorities: <ul style="list-style-type: none"> - Criteria for getting social security benefits are seen by farmers as too permissive and thus as a disincentive to work 	NRDP: <ul style="list-style-type: none"> - Support for investment in farm equipment and machinery to replace labour
6 – Change of agricultural policies and regulations	Farmers: <ul style="list-style-type: none"> - Learning which support measures are better adapted to their needs and how to adapt to changes 	Consultants / implementing agencies: <ul style="list-style-type: none"> - Collaborate with farmers to help them dealing with changes - Collecting and evaluating comments and complaints from farmers about problems encountered MARD: <ul style="list-style-type: none"> - Evaluate measures with favourable impact or do not work - Correct amounts of funding, eligibility and implementation of rules 	Facilitating communication among all stakeholders: <ul style="list-style-type: none"> - Monitoring committees - Organizing workshops, debates



Challenge	Actors	Institutions	Resources
7 – Price scissors	Farmers: <ul style="list-style-type: none"> - Poor ability to anticipate market evolutions Government: <ul style="list-style-type: none"> - Before EU accession: intervention on product process and input prices EU: <ul style="list-style-type: none"> - After accession: intervention through CAP MARD / paying agencies: <ul style="list-style-type: none"> - Managing agricultural policies 	Farmers: <ul style="list-style-type: none"> - Trying to speculate on market trends CAP: <ul style="list-style-type: none"> - Regulations for agricultural prices and subsidizing agricultural inputs MARD: <ul style="list-style-type: none"> - Price monitoring system on regional basis 	MARD (before EU accession): <ul style="list-style-type: none"> - price support for basic agri-food products (bread, milk, pork and chicken meat) - subsidies for agricultural inputs EU: <ul style="list-style-type: none"> - CAP payments



Table 6. Response to challenges - synthesis

Challenge	Actors	Institutions	Resources
1 – Extreme weather conditions	Farmers: <ul style="list-style-type: none"> - Setting up associations of water users - Change of farm profile (alternative crops/animals) Consultants / researchers: <ul style="list-style-type: none"> - Disseminating information on changes in technologies Government: <ul style="list-style-type: none"> - Support for irrigation systems development through NRDP 	Consultants: <ul style="list-style-type: none"> - Providing advice for new crops/animals/technologies Government: <ul style="list-style-type: none"> - Accountability on long-term impact assessment and alleviation 	Farmers: <ul style="list-style-type: none"> - Own funds NRDP– funds accessible through projects regarding: <ul style="list-style-type: none"> - Anti-hail nets - Investment in irrigation infrastructure - Investments for restoration of agricultural land production potential
2 – Poor integration of small farms in agri-food chains	Farmers: <ul style="list-style-type: none"> - Adapting/changing production structure to better respond to market demand or processors/retailers Supermarket chains: <ul style="list-style-type: none"> - Special programs for associations or small farmers GAL: <ul style="list-style-type: none"> - Stimulating association and helping them to access funds 	NRDP: <ul style="list-style-type: none"> - Programs and incentives supporting cooperation among farmers MARD: <ul style="list-style-type: none"> - Regulation aiming at including a specific quota for the national products in supermarkets 	NRDP – funds accessible through projects regarding: <ul style="list-style-type: none"> - Support for horizontal and vertical cooperation among actors in the supply chains - Investment in milk collection equipment - Investment in storage facilities for vegetables and fruit - Investment in small-size slaughterhouses in mountain areas Supermarkets: <ul style="list-style-type: none"> - Investments/programs for establishing cooperatives by local farmers
3 – Business development	Farmers: <ul style="list-style-type: none"> - Accepting the need for change and actively looking for information Consultants / input suppliers / innovation developers:	NRDP: <ul style="list-style-type: none"> - Regulation principle regarding the novelty of technological acquisitions Consultants (public advisers):	NRDP: <ul style="list-style-type: none"> - Investment in innovative technologies - Support for small farms to shift from semi-subsistence farms to small-medium farms commercially oriented



Challenge	Actors	Institutions	Resources
	<ul style="list-style-type: none"> - Disseminating information and knowledge through specialized fairs, presentation days, demonstrative farms Banks & Government: <ul style="list-style-type: none"> - Facilitate access of small farmers to loans 	<ul style="list-style-type: none"> - Should be properly qualified and well informed - Help farmers to prepare projects for accessing funding through NRDP Government / public administration: <ul style="list-style-type: none"> - Continuous improvement of legislation, regulations, fiscal policies - Ensuring proper functioning of Agricultural Chambers Schools / universities: <ul style="list-style-type: none"> - Introduction of new education programs - Modernizing curricula, adapted to current trends in modern agriculture 	Banks: <ul style="list-style-type: none"> - Loans to small farms for co-financing NRDP projects
4 – On-farm diversification and integration	Farmers: <ul style="list-style-type: none"> - Accepting the need for change and actively looking for information Farmers' associations / LAG: <ul style="list-style-type: none"> - Promoting diversification, acting as facilitators, providing solutions 	Banks: <ul style="list-style-type: none"> - Facilitating access to funding for farmers or farmers' associations with initiatives in diversification Government / public administration: <ul style="list-style-type: none"> - Providing an appropriate legislation Research-development: <ul style="list-style-type: none"> - Developing new products - Providing new ideas and solutions in: products processing, services, handicrafts, agri-tourism, other non-agricultural activities 	NRDP: <ul style="list-style-type: none"> - Support for conversion to organic farming and for maintaining organic farming practices - Setting up and development of non-agricultural activities in rural areas - Support for increasing the added value of agricultural products, promoting short supply chains - Support for establishing and developing small businesses and job creation
5 – Lack of available labour	Farmers:	MADR: <ul style="list-style-type: none"> - Revised rules for the farmers' early retirement scheme 	NRDP:



Challenge	Actors	Institutions	Resources
	<ul style="list-style-type: none"> - Young farmers with changed mentalities: which see the farm as an economic asset and manage it as a business 	<ul style="list-style-type: none"> - Better rules for “Diaspora start-up” program Government: <ul style="list-style-type: none"> - Actions aiming at reversing demographic trends 	<ul style="list-style-type: none"> - Support for investment in farm equipment and machinery (to replace labour) - Support for young farmers’ installation - Support for early retirement scheme - Support for new farms started by young farmers that returned from working/studying abroad - Support for business start-up by Romanians that return from working abroad
6 – Change of agricultural policies and regulations	Farmers: <ul style="list-style-type: none"> - Are increasingly accessing and using available funds, while struggling to adapt to changes 	MARD: <ul style="list-style-type: none"> - Make EU and national regulations compatible, eliminate all mismatches and conflictual legal provisions - Better adapt regulations also to the needs of small farms - Ensure that national regulations are non-discriminatory as compared to those implemented in other member states Implementing agencies: <ul style="list-style-type: none"> - Improvement of their human capital - Improvement of knowledge and skills in implementation of NRDP measures, in laws and regulations interpretation 	Facilitating communication among policy makers, implementation agencies and beneficiaries: <ul style="list-style-type: none"> - Knowledge building, learning and communication
7 – Price scissors	Farmers: <ul style="list-style-type: none"> - Searching for new market niches Input and innovation providers:	CAP: <ul style="list-style-type: none"> - Incentives supporting innovation adoption 	Farmers: <ul style="list-style-type: none"> - Own funds NRDP:



Challenge	Actors	Institutions	Resources
	<ul style="list-style-type: none"> - Developing less expensive and higher yielding technologies <p>Media:</p> <ul style="list-style-type: none"> - Promoting innovative ideas and good practice models <p>Research and development:</p> <ul style="list-style-type: none"> - Inform farmers and media about innovative solutions developed by them 		<ul style="list-style-type: none"> - Funds accessible through projects



4.3 System archetypes

Trying to classify the challenges identified for the small mixed farming system in Nord-Est Romania into system archetypes (Kim, 2000) proved difficult and did not show always a good fit.

The dynamics of challenge *extreme weather conditions* can be approximated by the archetype “fixes that fail”. The small farmers avoid making insurances, unless obliged by the conditions of funding under NRDP programs (they think that insurance premiums are too high and the insurance companies do not cover their losses in case of disasters, under various false pretexts). On the other hand, the insurance companies do not offer instruments tailored for the small farms’ needs. In case of minor losses, farms cover them from own savings. In case of major losses, they apply for support from the government financial support. The farming system has insufficient capacity to cope and to respond, so it triggers a request to the enabling environment to mobilize resources. The support obtained is only temporarily fixing the immediate consequences (only partially cover losses), and farmers will keep not making insurances in the future. The support is very costly for public finances, and thus fails to provide a solution for the structural problem: need of important investment in irrigation facilities.

The dynamics of challenge *poor integration of small farms in agri-food chains* may be approximated by the archetype “growth and underinvestment”. Small farms are making efforts to increase their performances and production, but the processors are not interested to buy their products (either due to high transaction costs or cheaper imports). So, farms are obliged to sell to middlemen at low prices. Lower incomes do not allow for investing in capacities needed to grow the business.

The dynamics of challenges *business development* and *on-farm diversification and integration* can be approximated by the archetype “success to the successful”. It is rather difficult for small farms to succeed in accessing funding programs through NRDP. They must fulfill a lot of conditions and criteria, and generally must be helped by consultants in preparing the proposals. But once obtaining a funding, and start to develop, it is much easier for them to access further programs, once being able to demonstrate earlier success. On the other hand, many of those who fail are generally not inclined to try again.

The dynamics of challenge *lack of available labour* can be approximated by the archetype “fixes that fail”. The issue of migrating workforce has worsened after EU accession. The farming system has insufficient capacity to cope and to respond to this challenge. The NRDP offers various types of support aiming at attracting young farmers to stay and develop farms in Romania, but results have been minor. Major structural changes are needed (increase size and efficiency of farms, diminishment of number and size of small subsistence and semi-subsistence farms, etc.) to make

farming activity attractive for young farmers, but it will take much effort and time, since such transformations cannot occur on short term.

The dynamics of challenge *change of agricultural policies and regulations* can be approximated by the archetype “limits to success”. The policies and regulations aim at supporting the farming system to perform better and develop. The policy makers and implementation agencies are evaluating the impact of the measures and try to improve them to benefit the farming system. But this results in more monitoring and controlling measures, more bureaucracy and continuously adjusting rules and regulations, to the increasing frustration and decreasing ability of the farmers to understand and apply them correctly. So, the adjustments and improvements become at a certain moment limiting factors.

The dynamics of challenge *price scissors* can be approximated by the archetype “fixes that fail”. Increasing input prices and decreasing products prices are detrimental to the economic viability of the farming system. Coping and response mechanisms are aiming at increasing productivity to lower the unit costs and increase income by selling more. Enabling environment acts by providing support (direct payments, subsidies for products or for inputs). But in the end it is quite costly for the budget and does not eliminate the initial problems.

4.4 Patterns across challenges

The interesting pattern is that most of the challenges are trends, so they are continuous, they are going on since a long time. The system developed a wide range of coping and response actions but was not able to solve these problems which are structural, so the challenges remained.

Table 7. Influence of challenges on the farming system resilience and links to approximative archetypes

Challenge	Type of challenge	Archetype	Influence on the farming system resilience
1 – Extreme weather conditions	Noise	Fixes that fail	bad
2 – Poor integration of small farms in agri-food chains	Trend	Growth and underdevelopment	diversified
3 – Business development	Trend	Success to successful	good
4 – On-farm diversification and integration	Trend	Success to successful	good

Challenge	Type of challenge	Archetype	Influence on the farming system resilience
5 – Lack of available labour	Trend	Fixes that fail	bad
6 – Change of agricultural policies and regulations	Noise/cycle	Limits to success	good
7 – Price scissors	Trend	Fixes that fail	bad

In case of archetypes “fixes that fail” and “limits to success”, various measures were taken, accompanied by financial support, but they proved unable to tackle and solve the core problems related to the respective challenges.



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D6.2 SWEDEN

Work Performed by P6 (SLU)

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1 INTRODUCTION

The aim of this case study (CS) report is to identify integrated sets of conditions that provide an enabling environment (EE) for the resilience of the high-value egg and broiler production in Sweden. The report integrates findings from the SURE-Farm work package (WP) 2 (Fowler, et al., 2019, Soriano, et al., 2020, Urquhart, et al., 2020), WP 3 (Coopmans, et al., 2019), WP 4 (Feindt, et al., 2019) and WP 5 (Accatino, et al., 2020, Reidsma, et al., 2020, Reidsma, et al., 2019).

The CS results are summarised in three sections. Section 1 identifies the farming system (FS) and the EE actors and institutions. Section 2 presents the main challenges over the last 10 years. Section 3 analyses the possible impact of the identified challenges on the delivery of the system functions, the anticipation, coping (robustness), and the response (adaptability and transformability) of the actors characterising the FS. Finally, Section 4 of the summary results, is a pattern analysis on the information presented in Step 1 – Step 3, showing how actors and challenges interact while building the resilience of the FS.

The findings contribute to Task 6.1 analysing the EE for the resilience of the FSs in Europe.

2 SUMMARY RESULTS

2.1 Farming system and enabling environment actors and institutions

This section lists and describes the actors and the institutions shaping the resilience of the high-value egg and broilers FS in Sweden, and the respective EE. We distinguish between actors in the FS and in the EE (see Paas, et al., 2019). Findings show that farm households, hired workers, farmers' organizations, processors, input/feed suppliers, peers, neighbours, are among the actors of the FS (ideally) having mutual influence with each other. Branch organisations, advisors, retailers, consumers, governing bodies and research units are among the actors enabling the environment for the resilience of the FS.

Table 1 summarizes the actors and the institutions characterizing the FS, across five actor domains: enterprise, government, intermediary, Agricultural and Knowledge Innovation Systems (AKIS) and society.

Table 1. Actors in the Swedish high value egg and broiler dairy farming system and its enabling environment

Actors	Formal institutions	Informal institutions
Enterprise domain: <ul style="list-style-type: none"> • Farmers • Slaughter houses • Input suppliers (feed, technology, fertilizer, pharmaceuticals), • Farm organisations (Federation of Swedish farmers, Lantmännen- cooperative) • Retailers 	<ul style="list-style-type: none"> • Farming regulation 	<ul style="list-style-type: none"> • Attitudes and norms concerning sustainable farming (including animal welfare) • Attitudes towards collaboration
Government domain: <ul style="list-style-type: none"> • European Union • Ministry of innovation and entrepreneurship • Swedish Board of Agriculture • County Administrative Boards • Swedish Food Agency • Swedish Veterinary Institute 	<ul style="list-style-type: none"> • CAP • Regulation as issued by the Swedish Governmental Agencies focussing on quality control, business development, innovation, rural areas, food and regional growth 	<ul style="list-style-type: none"> • Accountability • Attitudes towards sustainable farming • Trust in authorities • Farmer participation in networks • Societal participation in networks
Intermediary domain: <ul style="list-style-type: none"> • Branch organisation eggs/broilers • Advisors • Banks 	<ul style="list-style-type: none"> • Regulations and standards 	<ul style="list-style-type: none"> • Ideal form of chain collaboration • Ideal farmer type
AKIS domain: <ul style="list-style-type: none"> • Networking - Branch organisation eggs/broilers • Networking - advisors 	<ul style="list-style-type: none"> • Vocational training, advisory services) 	<ul style="list-style-type: none"> • Technical vision on farming
Societal domain: Swedish Consumers' Association, NGOs (Djurens Rätt, Djurskyddet Sverige, WWF)	<ul style="list-style-type: none"> • Campaigns, animal welfare movements, Vego movements 	<ul style="list-style-type: none"> • Societal vision on farming

2.1.1 The enterprise domain

The farm. Families are the core when making decisions on the farms, including production, investments or business development. Farmers run their business in close connection with their partner but also parents or children (depending on the generation change status). For farmers whose children are not old enough or not interested in farming, hiring labour is a way to manage the work load. Having family members or employees that are skilled in all areas of the production is EE the robustness of the farm, as the production is not dependent on a single person.

Processors: slaughterhouses and packing companies. Processors especially for the broiler production, take an active role both in production prerequisites and in planning production-related activities. These processors impose requirements for quality control schemes, but also recruit, support and encourage farmers to either convert to (into broiler production) or develop their production. The larger scale egg producing companies also contract egg farmers that deliver to designated packing companies. However, for the egg production, buying companies are considered more of a supporting actor. Through the processors, farmers gain access to support from production advisors, something that the farmers consider positive for their farming businesses. Large-scale processors and farmers ideally should be mutually dependent, but farmers perceive their mutual influence as imbalanced. While farmers often depend on a single processor, processors do not depend on the single farm. Processors also operate in international markets and have the possibility to by-pass local farms (e.g., by importing organic eggs from Finland).

Farmers' organizations enable farmers to learn from each other, develop solutions for particular situations, and discuss what might work and not. Stronger links between farmers/farming union/producers organizations are also important to strengthen lobbying vis-à-vis policy-makers and authorities.

Input suppliers. Farmers are primarily dependent on the quality of the chickens delivered to the farm, and the fodder. While farmers are dependent on these actors to deliver high quality animals and crops, they are not able to influence them, and contracts make it difficult to choose other suppliers.

Retail: food stores/direct sales are of greater importance for the egg producers, because of the greater ease of selling a final product. Slaughtering and cooling requirements make direct or local marketing more difficult in broiler production. Retail belonged to the group of EE actors, as the effect on the production is indirect, mainly on the decisions related with the demand for eggs, poultry meat, and views on animal welfare.

2.1.2 The government domain

The government domain is represented by national and regional policy makers and authorities. These actors create policies and impose roles and regulations. Policy makers/authorities are considered important part of the EE as farmers have to make decisions to adapt to regulations and protocols. Actions undertaken by the actors belonging to this domain are considered as overdriven causing administrative burdens, which leads to a greater work load and hence increase costs. However, stricter policies and regulations initiate technological changes, and add value to the domestic production.

2.1.3 The intermediary domain

Branch organisations are umbrella organisations functioning to enable vertical integration of the FS. The respective branch organisations for the egg and the broiler production, connect farmers, agricultural cooperatives, slaughter houses, poultry hatcheries, packaging companies, input suppliers. Branch organisations take responsibility for vocational training, and organise workshop and seminars both for technicalities related to the primary production and farm management. Branch organizations are also involved into discussions on future policy making and regulations. Advisors help farmers to make decisions, provide new knowledge or suggestions on certain procedures in the production. As the branch organizations, advisors are highly appreciated by the farmers.

2.1.4 The AKIS domain

The AKIS domain is considered as an important part of the EE. This domain is represented by the networks facilitated by the branch organizations and advisory services.

2.1.5 Societal domain

Swedish high-value egg and broiler production is largely influenced by the actors representing the societal domain. In this group main role play consumers, animal welfare/right activists, consumers' organisations, media etc. Actors of the social domain belong to the group EE actors, as the effect on the production is indirect, mainly on the decisions related with the demand for eggs, poultry meat, and views on food safety and animal welfare. Actors representing the societal domain provide both positive and negative environment for the development of the production. For instance, consumers' and market trends are influential on farmers' decision-making related to production planning (e.g. direction and extent of developments) or applying new ideas. On the other hand, animal rights activists and social media are classified as a source of risk, influencing the consumers' demand. Animal rights activists are also considered as potential transmitters of animal diseases following illegal entry into stables without proper disease preventing measures.

2.2 Challenges and adverse events in the last 10 years

This section describes the main challenges affecting the resilience of the high value egg and broiler production in Sweden. High standards and regulations, changing consumers' preferences and generation renewal are the challenges associated with the delivery of the FS functions. The need for technology adaptations, increased production costs, the need for new knowledge and competence appear as consequences. The main challenges and the respective consequences are graphically presented in Figure 1.

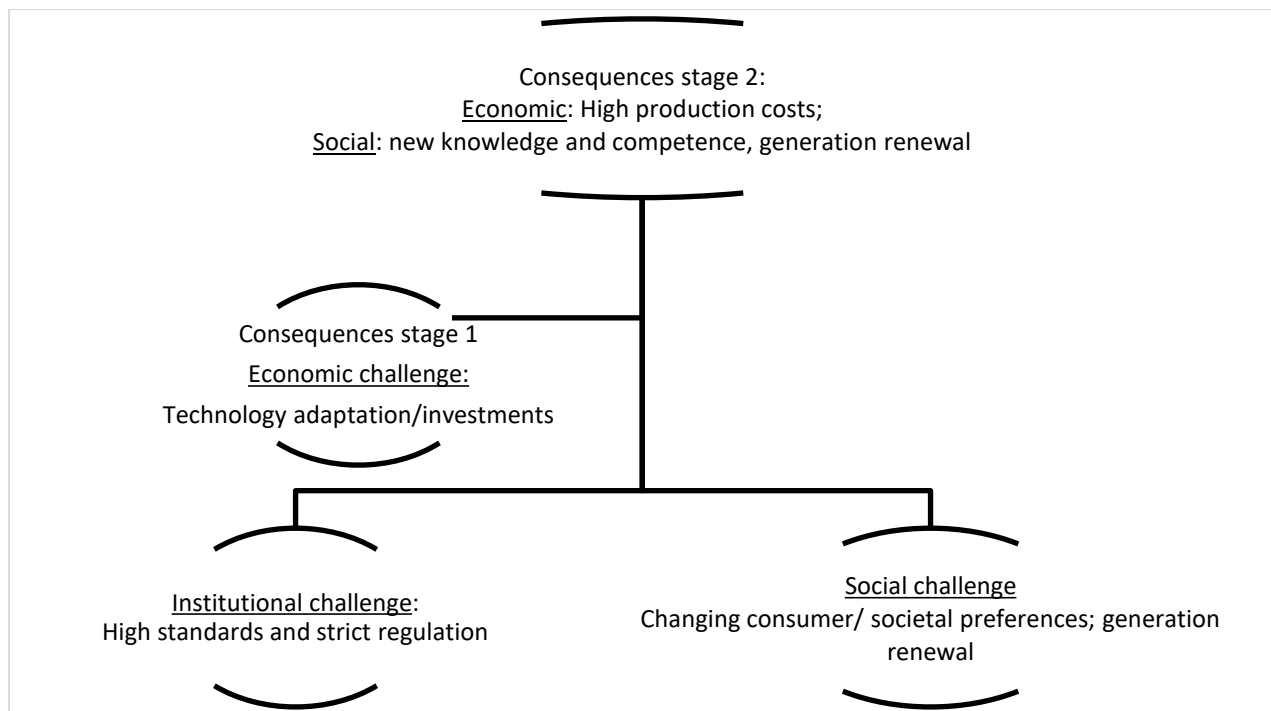


Figure 1. The main challenges of the high-value egg and broiler production in Sweden and their respective consequences

High standard and strict regulation are part of policy making decisions, where the possibility for the producers to impact the outcome is rather limited. Changes are continuous i.e. there are *trends*, following the societal pressure for safe food, good animal health and welfare, and good environmental practice. Thus, the aim for imposing high standards and strict regulations is improving the product quality, animal health-, welfare-, environment, climate conditions, and work-safety conditions. However, for the actors representing the farming system (e.g. farmers, processors) “standards and regulation are “unrealistic”, implemented within “unrealistic time frame”, causing problems with adaptation, bureaucracy, and increase the production costs.

Changing consumers'/societal preferences. Changes in consumers' demands are manifested as both long-term *trends* and *sudden shocks*. The long term trend follows the general trend for safe food, and good animal welfare and environmental practices. Sudden shocks are in most cases a reaction to information shared by the social media, NGO's and animal welfare activists.

Technology adaptations are applied as prerequisites for sustainable agriculture, including adapting to animal welfare, ethical and food quality issues. Technological adjustments are also applied as a response to scale economies, and productivity improvements, but also to make the farming activities less physically demanding. Technology adaptations increase the production costs (due to the investments) and the need for new knowledge. The pressure for technological adaptations is continuous and driven by changes in formal institutions and society (citizens, consumers, NGOs).

Generation renewal. Many farmers are placed in a setting of family based farm businesses. While, generation change comes in *cycles*, continuous efforts for building identity and early involvement of the young generation is an important factor. The generation renewal is also related with the economic situation on the farm. Well-functioning farms have a greater possibility for having a successor.

2.3 Response analysis

In this report, resilience capacities refer to the capacity of farms, farmers and FSs to anticipate (proactivity), cope (robustness) and respond (adaptability and transformability) to shocks and stresses (Duchek, 2020). Thereby, for each of the identified challenges in 2.2, this section describes the underlying consequences on the system functions, the anticipation, coping and the response of the actors characterising the FS. We assume that to deal with the challenges (anticipate, cope or respond), actors and institutions representing the FS and EE can invest in: i) resources e.g. financial and/or cognitive, in order to produce and support the production of public and private goods (fulfilling the system functions), and/or ii) resilience attributes e.g. profitability, modularity, openness, diversity, etc., for the EE.

2.3.1 High standards and strict regulation

Consequences of the high standards and regulations are mainly related to ensuring a sufficient farm income (negative), delivering high quality food products (positive) and animal welfare (positive).

High standards and strict regulations impose higher production costs and administrative burden. Changes in the production costs are related to the changes that are required within farm management and technology adaptations. FS actors believe that Sweden has higher production

costs due to much stricter standards and regulation, especially on animal welfare. For instance, the imported chicken meat which is produced under lower animal welfare standards is sold at lower prices on the Swedish market. Egg imports in Sweden are regulated with a requirement for certificates for salmonella free products (from all countries except Denmark, Finland and Norway), and the pressure for fresh imported eggs is lower. The administrative workload refers to the extra time and skills needed to keep up with the administration of quality controls, permits and other regulations especially for the farmers. As more than 90% of the farms are family farms, the issues of workload and labour are tied into the capacity of the family labour. In some cases, external labour such as advisors or hiring a person to those specific tasks is needed. On the other hand, high standards make the Swedish eggs and broiler products high valued, and more prioritized by the consumers. However, the largest share of the value-added remains with the processors and retailers. Farmers view the system as working against them, often neglecting fair competition as precondition for efficient markets. The problem is general for the whole value chain, as changes in standards and regulation are imposed on other actors as well (production, packing, transport, slaughtering, **processing**, sale, etc.). In general, actors of FS do not oppose strict regulation *per se*. It's rather that the EU competitors are not subject to the same regulation and enforcement, and that changes in standards and regulation must happen in greater harmony at the EU level to limit competition which was perceived as unfair.

Anticipation. For many imposed regulations, farmers must adapt to changes and regulations if they want to stay in the branch. The acceptance of high standards and regulations is highly influenced by the administrative authorities, processors and the branch actors.

The Response is facilitated by investing in cognitive resources, including knowledge and networks. For some farmers financial resources are also needed to pay for the extra labour to keep up with the administration burdens. Actors (e.g. farmers, processors) also invest in structural adaptation of buildings, production processes etc. Attributes facilitating the EE are mainly represented by the "openness" and "modularity". Actors invest in knowledge and build networks to gain/share knowledge and overcome the constraints. For instance, farmers seek advice for instance from consultants, advisors, family, other farmers and capacity building activities (for the family members and employees) to develop new work routines, to implement new regulation or to address challenges that require more substantial change at farm level. For the processors, adaptations are easily operationalised at organizational level (not relying on the capacity of the family members). Authorities should act a facilitators of the adaptation process, but are often seen by the producers as an obstructing factor.

2.3.2 Changing consumer preferences

Consequences from changing consumers' preference are related to delivering high quality food products (positive), animal welfare and ensuring (positive) a sufficient farm income (negative/positive).

Changes in the consumer demands are viewed by stakeholders as both, long-term trends and erratic and unpredictable. The long-term changes are to a large extent related to the need for high quality products. Products are highly valued for the low use of antibiotics for farm animals and good animal welfare and environmental standards, bringing competitive advantage to the domestic production. The self-sufficiency index for eggs is high with 97.5% (in 2019), and intermediate with 71.6% (in 2019) for broilers (Jordbruksverket, 2020). The consumers' interest for domestic production stimulate the production volume. Since 2010, the domestic production of eggs and broilers has increased by approximately 35%. For the same period, the export has increased by 180% for the eggs, and by 200% for the broiler meat (*ibid*). For a comparison, the consumption per capita is decreasing for all meat, and the production is decreasing for all animal products, except for broiler meat, eggs and beef meat (however, beef production receives coupled direct payments).

As for the challenges on high standards and requirements, adapting the production to the consumers' needs requires technology adaptations which further increases the production costs. Consequences of technology adaptations are discussed the next sub-heading.

Changes in the consumers' preferences originating from the social media/animal activist are sudden, and cause short term market perturbations, but the FS seems to be robust and recovers fast.

Anticipation. Having entrepreneurial mind-set, seeking for updating their knowledge/information update, actors to large extent follow how the market and the consumers' preferences develop. Farmers' anticipation is largely supported by the processors and the branch organisations. Farming neighbours contribute to sharing knowledge, ideas and experiences. The sudden shocks caused by social media, NGO's and animal welfare activists are unpredictable.

The response is facilitated by both by investing in resources (finances/knowledge/networks) enabling the delivery of the system functions, and in attributes ("openness"/"modularity") supporting the EE. While an entrepreneurial mind-set and a preference for experimentation was visible throughout the interviews, another aspect of trying on new ventures was an expression of responsiveness to market and consumer demand. Actors follow consumer trends and invest in ideas that are expected will meet consumer demands. For the farmers, being responsive to market changes is crucial to stay relevant. Farmers are "open" to learn from different knowledge

sources (e.g. education, vocational training, knowledge exchange, learning from experience, etc.) and try new things, constantly adapting to the market needs. All available labor is engaged into the knowledge building activities. Farmers' response capacity is largely supported by the processors and branch organisations, as intermediary domain providing information and knowledge for the ongoing changes, but also for connecting the various actors across the value chain.

2.3.3 Technology adaptation

Consequences of frequent technology adaptation are related to delivering high quality food products (positive), animal welfare (positive), the working conditions of the employees (positive), ensuring a sufficient farm income (negative).

As already mentioned (in 2.3.2.) the production is among the fastest growing, both in terms of production volume and exports, and the production is high valued/favoured by the domestic consumers. Adaptation to new technologies also implies improved productivity, and better working and social conditions (more free time is available) for the farmers. However, farmers work with low margins, and high debts for the investments.

Anticipation is highly influenced by regulations from administrative authorities, processors and the branch actors. For many imposed regulations, farmers have no choice but to adapt to changes and regulations if they want to stay in the branch.

Coping is mainly performed via continuous training for the family and the non-family members, and maintaining good networks, i.e. good relationship between farmers and other value chain actors.

The response is facilitated by investing in resources (finances/knowledge/networks) enabling the delivery of the system functions, and in attributes (openness/modularity/diversification) supporting the EE. Actors, (both farmers and processors) are proactive and pragmatic with applying the new technological solutions, and search for new possibilities for improvements (*openness*) expanding their business in size (to meet the scale requirement) or new ventures (*diversification*) to reduce the risk and/or increase the income on the farm. Farmers adopt new technologies both by 'learning by doing' and by experimenting with solutions, and then adapting their practices based on what they have learnt. Actors' responses for applying new technologies/experiments/projects connect the actors and the institutions of the FS. Farming neighbours help for the exchange of knowledge and experiences. Farmers' response capacity is also supported by production, financial or business advisors providing insights on new technologies. Furthermore, branch organisations as an intermediary domain provide information

and knowledge for the overall ongoing changes. The common agricultural policy (CAP) is also geared towards adaptation by providing support investments.

2.3.4 Generation renewal

Consequences of challenges related with generation renewal are mainly related to the future existence of farms, and thus the future delivery of the production.

Intergenerational shift is often key to allow access to being a farmer. Farm facilities are expensive and without an estate running in the family, it may be very difficult to enter farming. However, there are cases when the farming business is not inherited, and not all farmers have successors interested to take over the farm.

Anticipation. Generation renewal is a cyclic process, and farmers can follow the interest of their children for working with the farm.

Coping activities are undertaken for general labour availability. However, as planning generation renewal is a long-term process, activities undertaken by the actors representing the FS are classified as a response.

Response. When planning for the next generation to take over, farmers intend to include their children as much as possible in the farm work and management. That is in order to prepare the children for the future tasks and the lifestyle (the life quality and the workload). When more than one child is interested in continuing the farming business, diversifying or expanding the farm business allow for the upcoming generation to manage separate tasks within the farm. The common agricultural policy has a partial contribution to the adaptations by providing support to the young farmers to take over the farm management. Agricultural policy is also providing support for infrastructural development of the rural areas, aiming to make these areas more attractive for the younger generation.

2.4 Pattern analysis

We use the system archetypes by Kim (2000) to show how challenges, consequences of the challenges, actors, actors'- anticipation, coping and response explained in heading 2.1 -2.3 interact in building the EE and the resilience capacity of the FS.

Given how challenges, consequences, and actor's involvement are interrelated, we classify the FS archetype as "Drifting goals". In "Drifting goals" archetype, gaps between the goal and the FS reality can be resolved by corrective actions (B1) or by lowering the goal (B2). Within the balancing loop B1 if a gap exists, corrective actions are taken to keep the FS in equilibrium. For

gaps persisting over a long time, there is a pressure from the actors to lower the goal, and that is within the balancing loop B2. The main difference between B1 and B2 is that lowering the goal will close the gap, whereas corrective actions take time. (Kim, 2000)

Figure 2 shows the FS archetype for three challenges: “high standards and regulations”, “changing consumers’ preferences” and “technology adoption”.

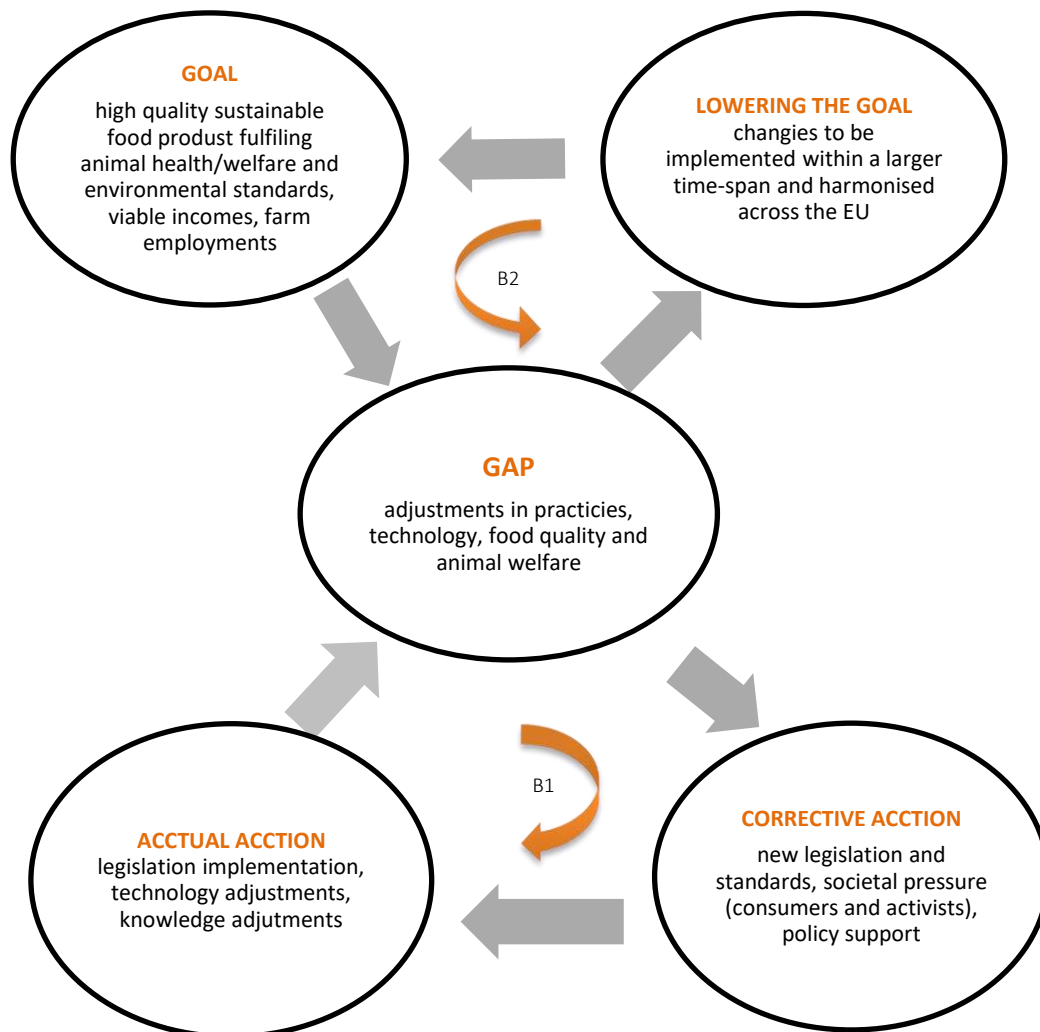


Figure 2. “Drifting goals” system archetype for: “high standards and regulations”, “changing consumer’s preferences” and “technology adoption” adopted from Kim (2000).

During past 20 years, the Swedish high-value egg and broiler production is undergoing continuous changes in “standards and regulations”, “consumer’s preferences” and “technology adoption”. These challenges are related to a common goal for producing high quality food products in a sustainable manner, while fulfilling animal/health welfare and environmental standards, achieving viable incomes and maintaining farm employments. The goal is high on the political

agenda (e.g. CAP, food policy), largely supported by the society and consumers (having high “willingness to buy” domestic products). The requirements for fulfilling the goal are continuous and require adaption of new legislation, via changing management practices, technology adaptations and knowledge adjustments. FS actors comply with the requirements and take corrective actions (B1), but also complain i.e. make pressure for *correcting the goal* (B2), in terms for the time span, and the unfair completion with the EU market, where the requirements are less demanding.

Corrective actions mostly in terms of responses enabling “adaptability” are undertaken at multiple level across the value chain, both by the FS actors and the institutions. Corrective actions are facilitated by investing in both i) financial resources and ii) cognitive resources, including knowledge and networks. Financial resources mostly loans are used for adaptations of physical infrastructure (farm buildings, production process, technology, new ventures), acquiring new knowledge, and for paying the extra labour to keep up with the administration burden.

The adaptation process is largely supported by the surrounding network including, family members and employees, branch organisations, financial advisors, farming neighbours, all contributing to the overall EE. The CAP is also geared towards adaptations by providing support for investments, experiments, etc. Authorities should act a facilitators of the adaptation process, but are seen by the producers as an obstructing factor. “*Openness*”, “*modularity*” and “*response diversification*” are among the main attributes that explain the EE of the FS. Actors, (both famers and processors) are proactive and pragmatic with trying and applying the new technological solutions, seek advice for updating their knowledge/information update on e.g. the development of the consumers’ preferences, or new regulation. They also search for new possibilities for improvements expanding their business in size (to meet the scale requirement) or new ventures to reduce the risk and/or increase the income on the farm.

Having entrepreneurial mind-set, actors follow how the technology and the especially the consumers’ preferences develop. Farmers’ anticipation is largely supported by the processors and branch organisations. However, for the imposed regulations, farmers have no choice but to adapt to changes and regulations if they want to stay in the branch. The sudden shocks caused by the social media, NGO’s and animal welfare activists are also hardly predictable. These shocks affect the demand in short run, but the FS remains robust.

The long run lasting *corrective actions* especially the investments and thereby the high depth rate, have contributed to bring the FS, especially the primary producers to critical threshold. However, the requirements for *lowering the goal* are not questioning the sustainability orientation, but the time and the scope of the implementation. Hence, requirements are that speed of

implementation of the new regulation should be slower, and the same regulation should hold for the whole EU market. Swedish authorities are proud of implementing sustainability related changes at the EU market, but the producers feel that it's all on their cost.

The FS archetype for the “generation renewal” challenge is presented in Figure 3.

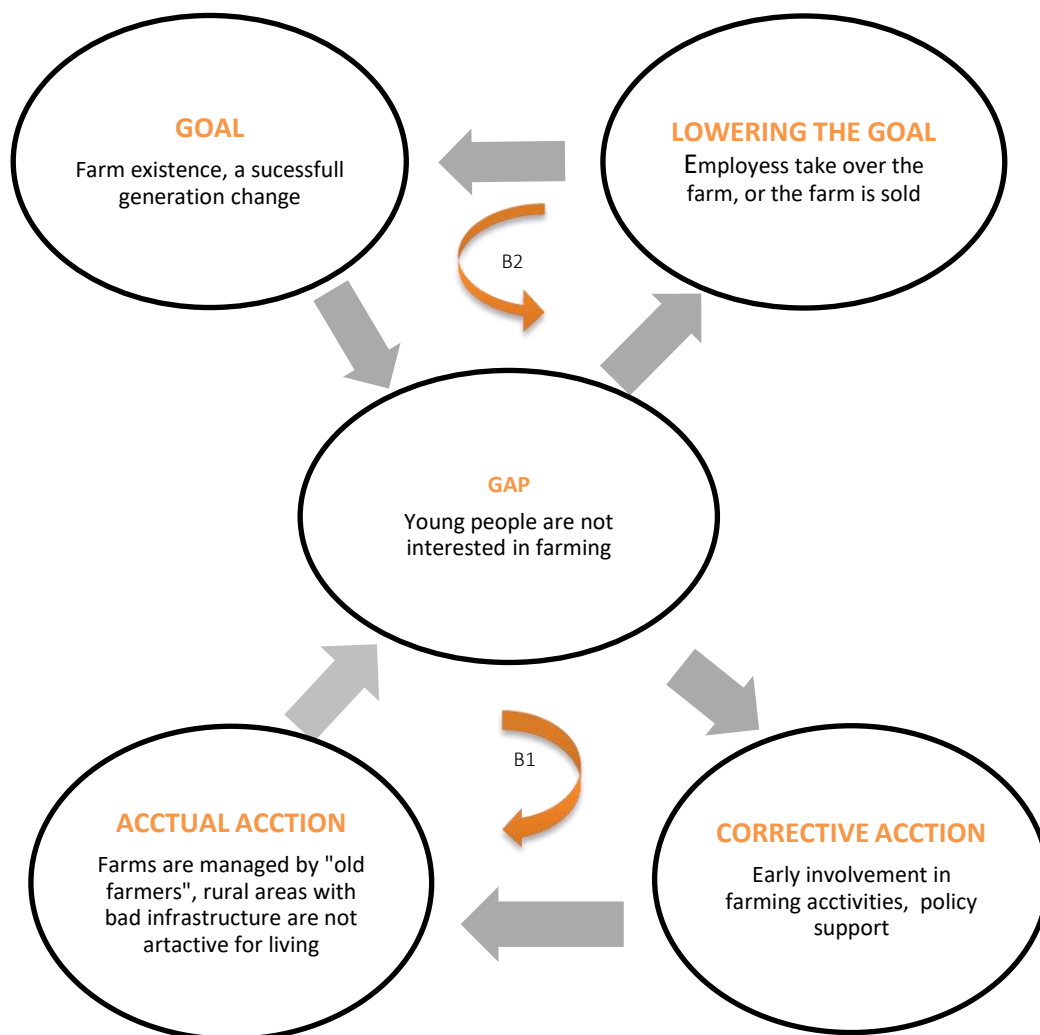


Figure 3. “Drifting goals” system archetype for: “generation renewal” adopted from Kim (2000).

The generation renewal is cyclic challenge for the farmers, but continuous process for the farming system. Consequences of challenges related with generation renewal are mainly related to the future existence of farms, and thus the future delivery of the production.

Intergenerational shift is often key to allow access to being a farmer, as farm facilities are expensive and without an estate running in the family, it may be very difficult to enter farming. Farm are mainly managed by “old farmers”, until they are retired (*actual action*). Taking over a

farm after parent's retirement seems difficult. In many cases, if not constantly engaged in the farming activities, the young generation starts new occupation/career. The low interest for farming, is often supported by the unattractive image for the rural regions, and the farming occupation per se.

Corrective action are taken by early involvement of the younger generation into the farming. That is in order to prepare the children for the future tasks, and the lifestyle (the life quality and the workload), i.e. to help them to build a farmer identity. Corrective actions are also undertaken by the CAP via the support to the young farmers to take over the farm management, and for infrastructural development of the rural areas.

Lowering the goal would imply selling the farm to employees or other farmers (B2), and in that way enabling continuation of the agricultural activity and the production. Farmers taking over the farm, will start the circle again, trying to keep the existence of the farm and transfer the tradition to the next generation.

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Project acronym: SURE-Farm

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D6.2 UNITED KINGDOM

Work Performed by P4 (UOG)

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STEP 1: FARMING SYSTEM AND ENABLING ENVIRONMENT ACTORS AND INSTITUTIONS

The actors involved in the farming system and enabling environment of arable farming in the East of England (UK) have been identified through the interviews and focus groups for *Deliverable 2.3 - Report on farmers' learning capacity and networks of influence in 11 European case studies* and *Task 2.4 - Focus Group on Risk Management Strategies*. In order to guarantee originality in the results and iteration in the process, the extraction and analysis of the actors has been initially conducted by a member of the UoG team that was not responsible for either D2.3 or T2.4; subsequently another team member verified the consistency and reliability of the results.

A total of twelve actor groups have been identified and displayed in Table 1. The twelve groups of actors have been re-classified in five actor domains (enterprise, government, intermediary, Agricultural and Knowledge Innovation Systems (AKIS) and society) providing details of the actors involved and their institutions. This information is reported in Table 2.

All the actors and domains listed in Table 2 have important roles in the enabling environment surrounding the farming system and, according to participants of a focus group held on the 27/06/2019 in Cambridge (UK) on Risk Management Strategies (T 2.4), in particular with respect to realising the following strategies: financial stability, increase efficiency, diversification and engaging in learning and knowledge exchange.

Table 1: Groups of actors in the arable farming system in East of England

Actor groups	Farming system	Enabling environment
Advisors	X	
Suppliers	X	
Processors	X	
Direct customers	X	
Final consumers		X
Cooperatives	X	
Farmers associations		X
Research institutions		X
Financial institutions		X
Government institutions		X

NGOs/ environmental/ conservation organisations	X
Media	X

In the enterprise domain, cooperatives contribute to the development of an enabling environment through collaboration, resource sharing and group-buying (economies of scale). Traders can contribute through their role to provide information to arable farmers on pricing/grain markets. If useful market intelligence is delivered in a timely manner, this can lead to more effective, better-informed decision making and increased efficiencies. However, it could be argued that in some cases there is too much information (“too much noise”) and that the right information is not being disseminated effectively.

Banks and credit institutes are a key source of funding support and therefore important actor for enabling the financial stability of the farming system. The role of banks as money lenders can be complex. A banker requires both a detailed understanding of the farm business and of the whole farming system. Bankers have to be prepared to take risks in order to allow businesses to invest or to develop long term plans. Though bankers cannot provide business advice as such (they are not insured for this), they can make suggestions on where to go for advice and can give information on banking products but must understand the implications involved with a farmer taking on a debt.

The government domain has a key role in the enabling of the farming sector and of the overall food supply chain. Policy bodies have a role to play in determining the functioning of the farming system as they are responsible for setting agricultural policy frameworks and directly supporting farmers financially through instruments such as the Basic Payments Scheme and agri-environment schemes. The government has also a role to play in shaping the nature of international trade and in providing information and evidence to farmers. Also at the local level, policy bodies can help to create an enabling environment of a farm business by developing policies and strategic support that enable more confident long-term planning.

Table 2: Actors in the East of England’s arable farming system and its enabling environment

Actors	Formal institutions	Informal institutions
Enterprise domain: Cooperatives, input suppliers (technology, fertilizer, pharmaceuticals), traders, retailers, accountants, banks,	Cooperatives PO Companies	Attitude towards cooperatives and POs Attitude towards private companies

insurance companies, land agents, real estate agents		
Government domain: European Union, Department Environment, Food & Rural Affairs (Defra), Natural England, Environment Agency? County Councils, local authorities, politicians, LAG	CAP, ELM, Regulations (Nitrates Directive, Water Directive, etc...)	Accountability Decision making Farmer participation Societal participation
Intermediary domain: Advisors, consultants, agronomists, AHDB, NFU	Public and private organizations Individual companies	Food chain management Governance Improve farmers negotiating power
AKIS domain: Academic and research organisations, universities, NIAB, ADAS, , specialised radio/TV broadcasts, trade press	Universities, Schools, Training institutes, Private companies, Associations Media	Innovations and R&D, Technology adoption Attitudes towards technologies
Societal domain: Other farmers, final consumers, LEAF, Suffolk Wildlife Trust, FWAG, social media	NGOs Public organizations Citizens Media companies	Societal vision on farming Environmental attitudes Consumers preferences

Within the intermediary domain, we consider advisors, consultants and agronomists as they bridge the knowledge and skills gaps between farmers and other actors of the supply chain, both up-stream (suppliers, input providers, ...) and down-stream (buyers, retailers, consumers). Among the advisors and consultants, there is a variety of actors with different roles within the farming system, such as crop advisors; succession planning advisor; advisors for organic farming; technical advisors; marketing advisors. In the East of England, business advisers provide a range of services to the arable farming system, including advising, mentoring, supporting, facilitating and coaching. Advisers may build a long-term relationship with a farmer and many will have a detailed understanding of a farm's history, which can help with forward planning and managing change and risk. They can play a vital role in a farm's financial stability through the business advice they provide and can have an important role in facilitating and arranging financial services/agreements (e.g. due diligence). Moreover, the role of agronomists in the arable sector is critical and it evolved over time, from simple advice on plant protection products to having a much broader knowledge of the agri-environmental scheme landscape.

Concerning the AKIS domain, public research organisations are amongst the actors with greatest impact on the enabling environment. Research, education and training institutes can provide data

and evidence used to underpin decision-making in a range of areas where improvements in farm business efficiency can be made. Moreover, also farmers networks have a key role in the AKIS domain. Talking to farming neighbours, engaging in discussion groups, observing what other farmers are doing and seeking out advice from other farmers are all useful occasions of learning when farmers want to try out something new and engage in trials. Some farmers highlighted that this networking and self-organisation between farmers has increased since ADAS, a government funded public research body, was privatised. Whereas ADAS was a key source of advice and information, farmers now look to their peers. Suppliers, such as equipment or seed suppliers, undertake research on their products and can influence farmers, but farmers felt that this was not always in their best interests.

In the societal domain, media are having a growing importance. On the one hand, the specialized media outlets on arable farming deliver vital information on all other domains (business, policies, supply chain, technologies, etc.). On the other hand, social media are becoming a critical tool for shaping and obtaining information on consumer preferences, environmental and ethical issues concerning agriculture, and public perception of agriculture as a whole. In addition, for the arable sector in East of England, the most important influencers of the farm manager on his/her decision making are family members. In most cases, the farms are family farms with several family members having a role in the farm management. Hence, decision-making is shared among family members and other people on the farm.

Finally, it should be noted that for the UK case study, the Brexit process will have a determinant role in shaping the future farming system and therefore the future enabling environment. Some farmers are holding back on further investment in the farm until they have a clearer picture of what the future of British farming will look like, while others are investing in expensive machinery now while they still have the single farm payment.

STEP 2: IDENTIFY CHALLENGES AND ADVERSE EVENTS IN THE LAST 10 YEARS

For the identification of the challenges faced and currently facing the arable sector in the East of England, we used the data collected through the SUREFARM survey conducted in November and December 2018 on 200 arable farmers of the case study region. More specifically, the challenges have been identified by, first, analysing two questions of the questionnaire developed by the SUREFARM consortium:

- Question 3a. Considering the next 20 years, what do you expect to be the 3 most important challenges on your farm? (Open question)

- Question 5. Considering the next 20 years, to what extent do you think that the following events will be challenging for your farm? Please circle your answer on a scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm).

In order to ensure that the challenges identified from the survey are not only concerning the future but are also relevant currently, they have been compared with stakeholders' discussions during the FOPIA workshops. As a result, we could identify six main challenges categories that we consider the most relevant for the UK case study.

Table 3 displays the six challenges categories and the most pressuring, specific challenge within the category, as well as a classification of the type of challenge based on Maxwell (1986).

The first main challenge concerns the economic aspects of the farming system, such as **markets and business**. In particular, the continuous **variation of arable commodities prices**, cereals in particular, is a source of concern and needs to be managed. Price volatility is inherent to agricultural markets; therefore it is a regular challenge, however exceptional spikes and drops are also occurring. For example, the covid crises contributed to higher prices volatility.

The second challenge concerns **policies and politics** and in the case of England is dominated by the uncertainties delivered by **Brexit**. Despite the referendum of June 2016 was previously organized and announced, its results were quite unexpected and unprecedented, having a clear shock effect. There are a variety of issues linked to Brexit, such as change in farm's subsidies, land management, environmental regulations, international trade, quality standards and delivery of ecosystem services.

Environmental sustainability is also an important challenge for the UK case study. Recently, the **ban on neonicotinoids** generated several challenges to farmers in the East of England. Although the ban probably benefited the environmental sustainability of arable farming, it was unexpected and not followed by alternative government plans to replace neonics with alternative efficient agro-chemicals products, thus having implications for the production of crops such as oil seed rape.

Table 3. Main challenges of the arable sector in the East of England

Challenge Category	Specific Challenges	Type	N. of farms in the survey
Markets and business	Price volatility	NOISE	119

Policies and politics	Brexit	SHOCK	113
Environmental sustainability	Neonics ban	SHOCK	81
Labour supply	Lack of skilled workers	TREND	34
Climate change	Droughts and floods	TREND	19
Succession	Low attractiveness for young farmers	TREND	17

Finally, we have identified three challenges that affect a lower number of farmers in the survey but that have clear trends characteristics as they started some decades ago and keep a negative trend since then. These are: i) difficulties in guaranteeing constant **supply of labour**, especially of specialized **skilled labour** for operating innovative machineries and equipment; ii) an increasing frequency of **droughts and floods** that are consequences of the global **climate change**; iii) difficulties in continuing the farming business from one generation to the other through **succession** or new entrants, as younger people move to different types of **job considered more attractive** from a stability and wage point of view.

STEP 3: RESPONSE ANALYSIS

In this section we present the response analysis for each specific challenge identified in Table 3. For each challenge the response analysis is reported in bullet points corresponding to:

1. Analysis of the possible **impact**
2. If and how the challenge has been **anticipated**
3. If and how the farming system has been able to **cope**
4. If and how the farming system has been able to **respond**

We start with **Price volatility**:

1. The main system functions impacted by price volatility are delivering healthy and affordable food products (food security) and decent livelihood quality in rural areas. This is because price volatility provokes income and farm profits instability, affecting the continuation of the farm business in the long-term as well as income levels in rural areas.

Moreover, low prices cannot guarantee high quality products for the food industry. As a result, the potential impact is an unsustainable business environment. The most recent event of price volatility is occurring this year (2020): wheat prices drastically increased after one of the worst harvests in 40 years, due to extreme weather (autumn and winter's heavy rains, followed by storms' floods and a dry summer) during the 2019-2020 season. As a result, the price of wheat increased by £40 a tonne (an increase of more 20%) and the price of flour increased by 10%. Since flour millers will have to make up the shortages with imports, the price of flour is expected to rise further and some of the increase will be passed on to consumers.

2. Agricultural markets are inherently volatile due to the nature of the agricultural business that depends on variable weather and natural resources. Therefore, price volatility is somewhat a constant condition for the farming system. In this sense it can be partially anticipated with market intelligence developed by buyers and suppliers. However, exceptional spikes and drops of commodity prices occur as well. These are less likely to be anticipated too far in advance as they depend on external and global factors which can be outside the farming system, such as extreme weather, sudden crisis (e.g. covid), speculations on the derivative markets, variations in the energy markets, etc. This is what occurred in the wheat season 2019-2020, where unpredictable and unprecedented extreme weather caused low wheat harvests and, consequently, a spike in wheat grains and flour prices.
3. The farming system is partially able to cope against price volatility. Instruments to cope with it are mainly market information systems. Therefore, actors such as cooperatives, farmers associations (AHDB, NFU), market advisors and consultants offer services such as early information systems on price trends and price data analysis. Farmers, with the help of advisors and agronomists, can also adopt mitigation strategies that can put in place before the sowing season (e.g. avoid planting crops for which low prices are expected and replacing with higher value crops) or after harvesting (e.g. change marketing strategies or outlets to obtain better prices). Also, the UK insurance sector is responding to price volatility of arable commodities, developing new index-based price insurances that trigger compensations once the market price falls below thresholds (see the insurance company Stable <https://stableprice.com>). However, none of these potential coping strategies significantly made a difference in the wheat price spike of the 2019-2020 season.
4. The farming system did not and is unable to respond significantly to price volatility and not changing or transformation is occurring in order to address this issue.

Brexit:

1. Brexit can affect both the delivery of public and private goods, either in a negative or positive way, depending on the future decisions and negotiations of the UK government. Brexit can affect all the sustainability pillars, having potential economic, environmental and social impacts. For example, in the event of a no-deal Brexit, wheat imports could be liable for a £79 per tonne tariff derived from the World Trade Organization (WTO) standard tariff for wheat. This would represent a further 40% hike in wheat prices. So far, impacts have been of a shock nature due to its uncertainty, and primarily on prices due to the drop of the British Pound exchange rate. However, it is expected that Brexit will trigger radical changes to the arable sector farming system in East of England. These changes are due to the new Environmental Land Management Scheme (ELMS) (currently being designed) that puts emphasis on the delivery of public goods and agro-environmental schemes and a progressive reduction of farms' subsidies.
2. This challenge was not anticipated prior to the referendum as the result was unexpected and no preparation was done in advance by any actor of the farming system.
3. There are two, opposite main coping strategies taken by the farming system. On the one hand, some farms are taking a wait-and-see strategy freezing any investment and excessive expenditure. On the other hand, some other farms are investing now in machinery and innovations to exploit the direct subsidies in the view of potentially losing them. Moreover, some businesses are exploring new markets alternative to the EU one, in preparation for a "hard" Brexit with difficult access to the usual EU partners.
4. This challenge is an ongoing issue. The response so far came mainly by the central UK government, which started the negotiating process with the EU and exploratory talks with alternative trade partners such as the USA, Australia and China. Moreover, the UK government did a public consultation for a vision of the future UK agricultural policies and started designing the ELMs.

Neonics ban:

1. The ban of neonicotinoids can have positive environmental impacts on wild bees populations improving ecosystem services such as pollination. Research estimates the value of the UK's 1,500 species of pollinators to crops at £400-680 million per year due to improved productivity (<https://www.gov.uk/government/news/further-restrictions-on-neonicotinoids-agreed>). On the other hand, it can have also negative impacts on private functions, such as loss of crops productivity due to crops failure as a result of pest infestation, and therefore public functions such as delivery of sufficient amounts of food. This impact occurred in the latest harvest season and it will also occur in the future if the

ban is not lifted or an alternative product approved for use. Questions whether the ban will continue after Brexit are still unanswered.

2. This challenge was anticipated as the ban started on the 27 April 2018 after several years of discussions about the environmental safety of neonics. However, the government decision to impose a ban was not accompanied by sufficient planning and the development of alternative insecticide products.
3. The farming system coped mainly through changing agronomic practices and using existing alternative insecticides. The main actors of the coping mechanism are farmers, agronomists, advisors and agrochemical companies. A number of alternative existing products were used and considered, such as flupyradifurone and sulfoxaflor, but their effectiveness in pest control was lower than neonics and, despite not banned, they are also considered as potential threats to bee colonies. Future coping strategies will rely mainly on R&D in public and private research institutes aiming to develop insecticides with equal effectiveness of the neonics but without the negative environmental impact on pollinators biodiversity.
4. The farming system did not completely respond to the challenge. Response was mainly coming from farmers and farmers' associations, which raised the issue of a lack of alternative to neonics and lamenting economic losses due to uncontrolled pests. However, positive responses to the ban came at the societal level from green NGOs supporting the ban and demanding a shift towards a more environmentally friendly farming system. The government did not follow up the problems generated by the ban with a clear response. However, farmers continue to demand greater planning and a revised regulation on the use of neonics.

Lack of skilled workers

- The functions potentially impacted by a lack of skilled workers are a reduced capacity of agricultural production, reduced productivity, marginalization of rural areas, reduced environmental sustainability due to incapacity to adopt sustainable practices and technologies. These impacts are currently occurring and are expected to worsen in the future. Moreover, is not only skilled work that is in shortage, but also seasonal and temporary workforce during sowing and harvesting seasons. The overall impact is a difficulty for the sector to deliver high quality and sufficient public and private goods, such as generating income and development in rural areas and sufficient high-quality food and environmental services.

- The problem of decreasing agricultural workforce is a long standing one. It was and it is anticipated since this trend continues from the 1950s, although it is likely to be exacerbated by a reduction in foreign labour after Brexit, and there is a current lack of foreign labour as a result of travel restrictions due to the Covid 19 pandemic. The main actors involved in detecting this problem are farmers, local and national policymakers, people living in rural areas and foreign worker recruitment companies (e.g Agriculture & Farming Jobs). However, it was and it is difficult to completely stop it.
- Given that the domestic offer of agricultural workers is quite low in UK, a main coping strategy has been the recruitment of foreign workers, seasonal or permanent, mainly from other EU countries such as Poland and Romania. Main actors involved in this strategy are farmers who hire foreign workers, recruitment companies and the national government with its immigration policies. Given that the Brexit campaign was strongly based on the immigration issue, it is not clear what will be the next immigration policy for agricultural workers in the future. Another coping strategy is through farmers networks and communities that can help each other in periods of needs.
- The issue is not solved and main response is taken by farmers' cooperatives, associations, unions, research institutes, universities and schools. The response consists of delivering training to improve the technical and managerial skills of agricultural workers. In other words, the response comes in the form of learning in different ways the necessary skills. Moreover, there is evidence that during the years the support provided to farms by the CAP helped in slowing down the out-farm migration of workers. In other words, subsidies did not completely change or transformed the structural process of workers abandoning the farming sector, but it helped delaying the process.

Droughts and floods:

1. In the last decades, the frequency of damaging weather events such as droughts and floods have increased and it keeps increasing both in number and intensity. The impact of these challenges is both on public and private functions of the farming system as they affect the agro-ecosystem environment reducing its natural resilience and the delivery of ecosystem services as well the production of crops and the profits in the farming system. These damaging weather events have impact both in the short-term, such as seasonal crops losses, but also in the longer-term, such as depleting soil nutrients and damaging soil structure. The long-term impacts can seriously affect the resilience of the arable

farming system in the UK as they are difficult to reverse. An additional important impact to be considered is the one that floods have on rural villages and communities, which can be severely damaging, endangering lives and quality of life. The latest wheat season 2019-2020 has been characterized by the worst episodes of extreme weather of the last 40 years. First off, unusually heavy rain in the autumn meant many farmers could not plant as much wheat as they usually would and what they did plant did not thrive in the waterlogged soil. That was followed by the wettest February on record, with storms Ciara, Dennis and Jorge causing widespread flooding. Then, spring was very hot and dry which caused droughts in many areas of the UK, making it hard for the crop to take up nutrients from the soil. Finally, the heavy rain in August provoked delays in harvesting. The combination of all these extreme events provoked a reduction of yields up to 40% and the redirection of large quantities of wheat from milling to feed wheat, overall causing shortages and price spikes.

2. Such events are linked to global climate change and the arable farming system alone cannot solve the problem. Despite knowledge on the occurrence of such events being available for a long time, there has been no anticipation or preventive action by the farming system. This was also due to narratives negating climate change that slowed down the decision-making process regarding mitigating the negative effects of climate change.
3. Currently, coping strategies are mainly adopted by farmers with the help of agronomists and advisors. Agronomic practices such as variations of sowing and harvesting dates and rotations help mitigate the negative effects. Public and private R&D are also developing coping mechanisms in the form of innovation and technologies. Seed companies are developing crop varieties that are drought-resistant and flood-tolerant. Agro-mechanical companies develop precision and digital tools for managing unfavourable weather conditions. Moreover, responsible land owners maintain irrigation canals allowing the flux of excessive waters and reducing water erosion, although many such water courses were not designed for such volumes of water. Finally, multi-peril crop insurances are used by farmers to obtain compensations against losses, although to the best of our knowledge there are no weather index insurances available yet on the UK market.
4. The response to such a difficult challenge is quite limited and comes mainly from national and local governments. Policy makers have a pivotal role in enabling the arable farming system against droughts and floods. First of all, by prioritizing in the policy agenda the climate change issue and therefore develop long-term strategies to guarantee the resilience of the arable sector. Second, by supporting farmers in the transition towards a climate smart agriculture. Third, by supporting public research in developing innovative tools for a climate smart agriculture and the management of disasters. Finally, by creating

a business environment for insurances and credit institutes that encourages the development of insurance and financial tools for farmers in areas at major risks.

Low attractiveness for young farmers

1. The succession of the farming business and the low attractiveness of it for young farmers is a key challenge for the arable sector in the East of England. This challenge can potentially threaten the very continuation and long-term existence of arable farming if new generations will not replace the old ones in the farming system. As a result, this challenge can affect some system functions such as food security, environmental sustainability, livelihood in rural areas, biodiversity and use of natural resources. These impacts are not currently occurring, but structural changes of the farming sector due to this challenge are happening, such as a concentration of the farming system towards fewer and larger farms acquiring farms with no successors or new entrants taking on the business.
2. The low attractiveness of farming for young and new entrants is an issue that has been long anticipated by the EU and its CAP, since its 2006 reform and subsequent reforms. However, the effectiveness of such support has been partial as it could not attract sufficient new and young entrants, although it might have slightly slowed down the average aging of the farmers population.
3. The coping strategy of the farming system against this challenge has been to encourage new and young farmers through improved training on the farming business, improved living conditions in rural areas to make them more attractive (e.g. more infrastructure and broadband services), and subsidies for the initial years of farming activity to compensate for the lack of initial productivity and income. The actors involved in the coping mechanisms are farmers, farmers' associations and unions, cooperatives and the government.
4. The farming system only partially was and is able to respond to this challenge. Policymakers have been active in addressing the issue with subsidies and facilitations in land rentals terms, but success was not huge. Different type of policies, maybe addressing the lack of initial capital of new and young entrants or addressing difficulties in the succession process might improve the response.

STEP 4: PATTERN ANALYSIS

System archetypes

We tried as much as possible to classify the six challenges into the system archetypes, although the exercise proved difficult and sometimes artificial as the system archetypes do not fully match the dynamics involved in the challenges of the arable farming system in East of England.

The dynamic of **price volatility** can be approximated with the system archetype **FIXES THAT FAIL**. Price volatility is a potentially strongly detrimental challenge for the arable farming system. Solutions are usually applied depending on the symptoms of price volatility, for example seeking compensations to lower profits through alternative diversified activities, but over time the problem comes back again as agricultural markets are inherently volatile. In this dynamic, the system shows partial resilience as it is able to cope with price volatility (up to a certain point and not when price spikes or drops are extreme) but cannot fully respond to it in such a way to eliminate it.

The challenge posed by **Brexit** can be approximated by a **GROWTH AND UNDERINVESTMENT** system archetype. The main argument for farmers during the Brexit campaign was about eliminating the excessive costs and burden of the EU bureaucracy and regulations that are supposedly holding back the growth of the UK farming sector; replacing the EU CAP with a UK policy that is more efficient and tailored around the UK farming systems; reduce immigration and therefore generate more jobs for local people. However, the current discussions around the potential impacts of Brexit highlight risks such as lowering quality standards and regulations of agricultural products in order to align with alternative trade patterns such as the USA; a fast reduction of financial support that will not give time for adaptation; a lack of necessary foreign workforce. Overall, farmers are worried that there will be significant cuts to government spending towards agriculture, prioritizing spending on other economic sectors and provoking a selection towards the more competitive large-scale industrial farming businesses. So far it is unclear the resilience of the arable farming system with respect Brexit as it is in progress.

The **ban on neonics** seems to be in line with the **ESCALATION** system archetype. In order to safeguard pollinators, policymakers decided to ban neonicotinoids-based agrochemicals, which was perceived by farmers as a threat to their capacity to produce crops. The coping strategy of farmers and researchers was to find alternative products already available on the market and to develop new ones in the medium-term. However, there is evidence that also the alternative products on the market might have negative effects on pollinators, leading policymakers to consider restrictions on their use as well. If this is going to happen, farmers and researchers will need to seek for “alternatives to the alternatives”. This can potentially generate a loop with negative effects on the resilience of the arable farming system. So far, the farming system did not demonstrate good resilience as neonics are difficult to replace with similarly effective products.

The dynamics of the challenge **lack of skilled workers** can be described by the system archetype **LIMITS TO SUCCESS**. The issue of agricultural labour supply and of agricultural workers migrating towards other industrial sectors is long known and has different roots and causes. One is the lower agricultural wages with respect wages in other industrial sectors. The main strategy adopted to workers in the agricultural sector is providing subsidies that can guarantee a minimum income. These efforts have been in place since 1992 and evidence on the impact of the CAP on agricultural labour suggests that it helped slowing down the process of workers out-migration but did not achieve the goal of stopping it. On the other hand, mechanization contributed to increase the productivity of labour, developing machineries to work on several hectares that can be operated by a single (skilled) worker. Such skilled workers are currently in high demand and strategies such as specialist training did not yet significantly improve the resilience of the farming system to this challenge.

Droughts and floods follow dynamics similar to the system archetype **SHIFTING THE BURDEN**. The farming system addresses mainly the symptoms of these challenges, by insuring against losses, adapting through agronomic practices, managing land with climate smart technologies and trying to develop resistant variety. However, the system is not addressing the principal cause of these challenges that is climate change, therefore delaying or delegating the fundamental solutions to the future and to actors external to the arable farming system, such as the transport and heavy industries. As a result, the arable farming system has a short-term resilience to droughts and floods, but not a long-term one.

Similarly to the lack of skilled workers, also the **low attractiveness for young farmers** can be described by the dynamics of the **LIMITS TO SUCCESS** system archetype. The reason is that, despite the efforts and funding devoted to this issue, the trend is not significantly improving even throughout the different type of policies for young farmers developed at the EU level. Policies and supports to young farmers keep changing over time in search of a solution, but the financial support given in the meantime seems insufficient or ineffective. So far, the arable farming system did not show a particularly strong capacity of resilience against this challenge.

Patterns across challenges

By confronting the type of challenges, some interesting patterns emerge. First of all, one can notice certain similarities in how the arable farming system behaves between noise challenges (Price volatility) and trends (Lack of skilled workers, Droughts and floods and Low attractiveness for young farmers). The similarity consists in the fact that all these challenges are continuous, they

are inherent or have persisted for a long time, therefore the farming system developed coping strategies but could not solve the issues.

Second, among trends the system archetypes are similar. Both *limits to success* and *shift the burden* dynamics indicate ineffective efforts to solve the challenges despite clear, prolonged and intense action being taken. This is probably due to the fact that the three trends (Lack of skilled workers, Droughts and floods and Low attractiveness for young farmers) are structural issues.

Finally, it is interesting to note that in the case of East of England arable farming the two shocks are of policy or regulation nature. They are sudden and show lack of preparation, planning and strategic response, causing uncertainty across the whole farming system. This raises questions about what actors are the most suited to address these challenges, given that governments and policymakers are involved in their insurgence.

Patterns across system functions

The main pattern emerged is that all challenges impact both public and private system functions. Among the public functions, all the challenges can ultimately affect food security. Among the private functions, all the challenges can ultimately affect the quality of life in rural areas.

Interestingly, the two challenges characterized as shocks (Brexit and neonicotinoids ban) do not have absolute negative impacts, on the contrary they can have also positive impacts on the system functions (e.g. environmental sustainability) depending on the future evolution of these challenges. For Brexit in particular it depends on the outcomes of the trade negotiations and of the political process for achieving a shared ELMs.

Roles of actors

Table 4 summarizes the roles of the actors in the six challenges identified, what resilience attributes the actor's domain strengthen, and what type of resilience capacity the actor's domain induces.

The **enterprise** domain strengthens the **modularity** attribute, as the domain displays internal division of roles among actors, each connected to the other. The resilience capacity induced by the enterprise domain is mainly **adaptability**.

The **government** domain is characterized by **openness**, as policies and regulations to address the challenges are connected in the different parts of the arable farming system. Somehow the government induces **transformability** as generates new visions of the farming system. Brexit is the major example of it.

In the **intermediary** domain each actor displays specialization of its role, suggesting a **diversity** attribute. Because the role of actors is mainly to maintain the status quo through mitigating the negative effects of challenges, the intermediary domain is characterized **robustness**.

Knowledge and R&D belong to the **AKIS** domain. They are fundamental resources for all the components of the arable farming systems, therefore suggesting **system reserve**. Innovation, technologies and knowledge provide **adaptability** capacity.

Finally, **tightness of feedbacks** is the attribute for the **societal** domain, as actions taken by any actor in the domain can affect and involved other parts of the society. The type of capacity induce is **adaptability**.

Roles of actors

Table 4. Roles of actors domains, what resilience attributes they strengthen and what resilience capacity they induce.

Domain	Enterprise	Government	Intermediary	AKIS	Societal
Challenges					
Price volatility	Market intelligence from buyers, suppliers, cooperatives, farmers associations. Innovative insurances from insurance companies		Advisors and agronomist suggesting mitigation strategies		
Brexit	Businesses taking wait-and-see strategy and freeze investments	Government started the negotiating process and public consultation			
Neonics ban	Suggestions from farmers, agronomists, advisors and agrochemical companies to change practices and use alternative insecticides.			Public and private research institutes develop new insecticides	Green NGOs supporting the ban
Lack of skilled workers	Farmers hiring foreign workers.	Government develops immigration policies		Research institutes, universities and schools delivering training.	Farmers networks and communities help each

	Cooperatives, associations, unions delivering training				other in periods of needs
Droughts and floods	<p>Agronomic strategies adopted by farmers with agronomists and advisors.</p> <p>Seed companies developing crop varieties drought-resistant and flood-tolerant.</p> <p>Agro-mechanical companies developing precision and digital tools.</p> <p>Insurance companies providing multi-peril insurances</p>	<p>Policy makers:</p> <ul style="list-style-type: none"> • providing safety nets and recovery funds; • developing long-term strategies; supporting transition to climate smart agriculture; • supporting public research in management of disasters; • encouraging financial tools 	Maintenance of irrigation canals from land owners	Public and private R&D developing climate smart technologies.	
Low attractiveness for young farmers	Associations, unions and cooperatives proving training	<p>Local governments improving livelihood conditions in rural areas.</p> <p>Government giving subsidies and facilitating rental terms</p>			

Resilience attributes	MODULARITY	OPENESS	DIVERSITY	SYSTEM RESERVES	TIGHTNESS OF FEEDBACKS
Resilience capacities	ADAPTABILITY	TRANSFORMABILITY	ROBUSTNESS	ADAPTABILITY	ADAPTABILITY



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