

# DiverIMPACTS

## Diversification through Rotation, Intercropping, Multiple cropping, Promoted with Actors and value-Chains Towards Sustainability

### Report

## *Addressing barriers to crop diversification: key elements of solutions identified across 25 case studies*

Work package: 5

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## Introduction

Crop diversification is recognised as a central strategy towards improved productivity, delivery of ecosystem services and higher resilience of cropping systems. Crop diversification thus can help reaching the EU environmental sustainability targets.

Although multiple benefits of crop diversification have been proven, the development of diversified cropping systems is still limited. In this context, a detailed analysis of barriers to crop diversification was undertaken based on the analysis of DiverIMPACTS' 25 case studies<sup>1</sup>, participatory workshops and a literature review. In total, 46 barriers to crop diversification were identified. Barriers occur at different levels: at the farm level; from harvest to retail; at the market level; and in the coordination between value chain actors (Morel et al., 2020). Following-up on this exhaustive identification of barriers, DiverIMPACTS WP5's team gathered their expertise for identifying direct solutions addressing the barriers.

The hereby report provides the solutions identified for the barriers to diversification at each level of the value chain and further discuss the conditions for enabling shifts towards more sustainable food systems.

Chapter 1 highlights the strategic axis and concrete solutions identified for addressing each barrier<sup>2</sup>. Chapter 2 offers an identification of the actors to be involved in the implementation of each solution. Finally, recommendations are provided regarding the implementation of solutions in an effective way.

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<sup>1</sup> More information on the DiverIMPACTS case studies is available at <https://www.diverimpacts.net/case-studies.html>.

<sup>2</sup> Barriers are described based on (Morel, et al, 2020) including the definition of the barrier and the identification of the context in which it has been encountered i.e. in niches, mainstream value chains or in farmers' innovation networks: three crop diversification innovation settings were identified by (Morel, et al, 2020): "W" stands for "Within the system", "O" for "Outside of the system" and "H" for "Playing horizontal".

# 1. Solutions identified by a group of experts for addressing the barriers to crop diversification

## 1.1 Preamble: list of the barriers to crop diversification

Table 1: Barriers to crop diversification at the different levels of supply chains (Morel *et al.*, 2020).

Stage	Barrier description	Barrier code
Agricultural production	Lack of technical knowledge and references	K_Tec
	Lack of economic knowledge and references	K_Eco
	Need of investment for adapted machinery	Machin_Invest
	Lack of technical knowledge and references about impacts on sustainability	K_Sustain
	Profitability is low, problematic or uncertain	Profit
	Uncertainties, risks and variability of agronomic performances	Uncert_Perf
	Lack of technical knowledge about the impact on farming system and design	K_Syst
	Lack of information because of problems with advisory context	Advice
	Current situation is still profitable on the short term	Current
	Constraints in labor organization (period, volume), mental or physical load	Work
	Barriers related to CAP*, environmental or sanitary regulations	Reg
	Lack of adapted plant varieties in the local context	Varieties
	Need of innovation in machinery for field activities	Machin_Innov
	Low agronomic performances (yield, quality)	Perf
	Increased complexity for management and decision-making	Complex
	Cultural barriers, confrontation with farming practices of parent's generation	Trad
	Cognitive frame and ways of thinking need to be changed	Cogni
	Seeds are hard or expensive to get	Seeds
Farmers' lack of awareness about issues linked to specialization	Awar_Farm	
Lack of available or adapted phytosanitary solutions	Phyto	
From harvest to retail	Volumes are too limited in a given area to be profitably or easily collected	Coll_Vol
	Equipment for screening, cleaning, drying or storing requires investment	Pre_ProInvest
	Equipment for processing requires investment	Process_Invest
	Competition on the global market with crops produced cheaper elsewhere	Compet
	Equipment for screening requires investment	Screen_Invest
	Equipment for processing requires innovation	Process_Innov
	Regulations issues around sanitary, quality and purity aspects	Qualsan
	Equipment for cleaning, drying or storing requires innovation	Pre_ProInnov
	Administrative, fiscal or accounting issues	Admin
	Equipment for screening requires innovation	Screen_Innov
	Traders are reluctant to support solutions which may reduce inputs that they sell	Input
	Dealing with diversification products brings higher costs	Cost
Market	Need to raise consumer's awareness or bad visibility of diversification benefits	Awar_Comm
	Uncertain or unstable market	Uncert_Mark
	No pre-existing or very limited market	Exist_Mark
	Doubts about willingness of consumers to pay more for diversification products	Willing
Coordination between value chain actors	No ensured and/or fair sharing of added value between actors	Price
	No ensured or limited volumes to buy/sell products or establish secure contracts	Quant
	Duration of contracts not enough to secure farmers in taking risks and investing	Dura
	Limited or no cooperation between innovative farmers	Orga
	Individualistic mentality and lack of trust between farmers limit collective action	Indiv
	Unbalanced power in bargaining between farmers and traders	Power
	Finding suitable contracts to address issues related to variability in production	Variab
	Lack of communication between value chain actors	Comm
	No ensured quality of products to be bought, sold or to establish secure contracts	Qual
	No ensured reciprocal benefits in partnership (especially for land arrangements)	Benef

## 1.2 Solutions for addressing barriers at the farm level

At the farm level, a total of twenty barriers to crop diversification were identified by Morel *et al* (2020). Those barriers encompass a wide range of dimensions, ranging from technical to behavioural aspects as well as profitability matters and adequacy with regulations (Table 1).

### 1.2.1 Barrier « Lack of technical knowledge and references » (K\_Tec)

#### 1.2.1.1 Barrier description

This barrier highlights farmers' lack of knowledge and references for the technical implementation of new farming practices. As an example, farmers may need further technical references for stabilizing or increasing the yields of minor crops they newly grow.

It is a transversal barrier found both in mainstream and niches value chains. It was identified in 21 of the 25 case studies (Morel *et al.* 2020).

#### 1.2.1.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing further knowledge through experimentation**, and **b. strengthening access to, or distribution of, knowledge to actors** (Figure 1). These solutions apply both to conventional and organic farming contexts.



Figure 1 : Key elements of solutions to the K\_Tec barrier.

The objective of developing further knowledge (a) can be implemented through:

- › Experimentation and identification of technical solutions by farmers (individually or as a group);
- › Field experiments and development of complementary knowledge on a specific crop by the organization that will buy it (downstream actors), relying on research institutes or/and networks of "pioneer" farmers.

The objective of strengthening the access to, and distribution of knowledge to actors (b) can be pursued through trainings, etc.:

- › Farmers' sources of knowledge may usefully be diversified, extending usual knowledge channels to colleagues, neighbours, thematic networks at the regional or national scale, farmers or advisors from other regions or other countries.
- › Farmer-to-farmer knowledge exchange is seen as a highly efficient way to diffuse knowledge & practical experience.
- › In addition, training programs in high schools and agronomic schools focusing on crop diversification and innovative crops should be strengthened. Farmers' trainings could also be

developed in collaboration with professional agricultural organizations and value chain stakeholders.

- › Knowledge sharing can also take place within new value chains.

A special attention should be paid to differentiating between universal and local references, i.e. references that can be generalized vs. references that need to be re-assessed locally.

## 1.2.2 Barrier « Lack of economic knowledge and references » (K\_Eco)

### 1.2.2.1 Barrier description

This barrier highlights farmers' lack of economic references on diversification practices.

In particular, the economic cost and benefits of strip cropping and intercropping practices are not clearly assessed yet.

The lack of economic references also applies to the collaboration between farmers. As an example, a farmer may be interested in adding a winter cover crop to the farm rotation but may not know how to make it profitable; letting the neighbour's sheep graze his winter cover crops can be an option, but the advantages and risks of this practice have to be assessed<sup>3</sup>.

This barrier was identified in 16 of the 25 case studies.

### 1.2.2.2 Key elements of solutions

Two main types of solution were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing further knowledge and references**, and **b. strengthening access to, and distribution of knowledge** (Figure 2).

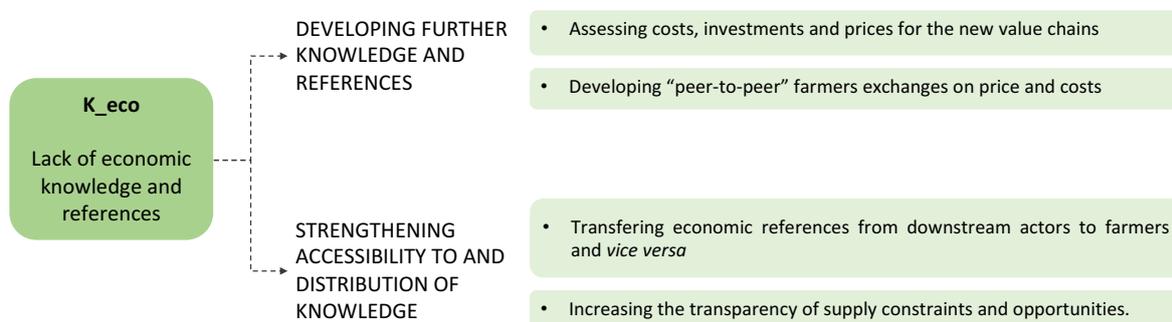


Figure 2: Key elements of solutions to the K\_Eco barrier.

The objective of developing further economic knowledge and references (a) can be reached through:

- › A comprehensive assessment of the costs, investments and prices in the new value chains;
- › The facilitation of farmers-to-farmers exchanges on prices and costs.

Strengthening accessibility/distribution of knowledge (b) can be implemented through:

- › The transfer of economic references from downstream actors to farmers (and *vice versa*) through collaboration, contracts and negotiation;
- › Increasing the visibility of supply constraints and opportunities (both in terms of quantity and quality) with a specific attention to price-related information.

<sup>3</sup> i.e. how much the sheep grazing would increase plot's fertility, thereby reducing fertilization costs? Would the sheep let the field in a good state for the farmer to sow a new crop in spring, without having to spend time and money on field preparation?

## 1.2.3 Barrier « Need of investment for adapted machinery » (Machin\_Invest)

### 1.2.3.1 Barrier description

This barrier highlights farmers' challenge to invest in farming machinery for specific cropping operations such as weeding in new crops, sowing and/or harvesting intercrops, etc.

This barrier was identified in 13 of the 25 case studies. It applies both to small-scale production (where the financial resources for investing in new machinery are limited) and larger farms (where large investment in mainstream machinery are already organised and the return-on-investment for innovative machinery and practice might not be competitive with the major crops).

### 1.2.3.2 Key elements of solutions

Two types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. limiting the investment costs**, and **b. securing the demand** (Figure 3).



Figure 3 : Key elements of solutions to the Machin\_Invest barrier.

The objective of limiting or lowering the investment costs (a) can be pursued through:

- › Promoting the acquisition of second-hand machines instead of new machines;
- › Encouraging co-investment in adapted machinery by a group of farmers who will organize themselves to share the equipment;
- › Supporting the adaptation of the existing equipment to fit the new crop;
- › Renting machines to other actors (farmers' network or companies) who can provide the adapted machinery (and often the labor and related expertise);
- › Adapting capital expenses (investment) to the area to be cropped and volumes to be produced.

The objective of securing the demand (b) can be implemented through:

- › Guaranteeing sufficient market outcomes.

## 1.2.4 Barrier « Lack of technical knowledge and references about impacts on sustainability » (K\_Sustain)

### 1.2.4.1 Barrier description

This barrier highlights farmers' lack of knowledge and references about the impact of new practices in terms of sustainability.

It is a barrier found in the 'changing from within' context (i.e. in conventional farming context), as to convince farmers within the dominant food systems to switch to more agroecological systems, there needs to be more available knowledge and references proving the potential benefits of crop diversification for the sustainability of their farm. On the other hand, the absence of this barrier is linked to the 'building outside' setting (i.e. in organic farming context) since farmers involved in alternative approaches are generally well aware and convinced of the benefits of crop diversification on sustainability. It was identified in 12 of the 25 case studies.

### 1.2.4.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a.** developing further knowledge through monitoring and experimentation, and **b.** strengthening accessibility/distribution of knowledge to actors (Figure 4).



Figure 4 : Key elements of solutions to the K\_Sustain barrier.

The objective of developing further knowledge (a) can be implemented through:

- › Field experiments for assessing the impacts of new crops/practices in terms of sustainability;
- › The monitoring by farmers of the impacts at the farm or plot scale.

The objective of strengthening accessibility/distribution of knowledge (b) can be pursued through:

- › Information on assessment tools<sup>4</sup> and knowledge regarding the impacts of new crops/practices on sustainability by public organisations, research and advisory institutes;
- › The labelling of products with high ecological value, highlighting their sustainability benefits;
- › Training programs for farmers about sustainability indicators they could follow on their farm and sustainable practices to implement.

Efforts should be made to ensure adequate recognition of relevant references by the consumers, retailers and industries.

<sup>4</sup> E.g. Systerre.

## 1.2.5 Barrier « Profitability is low, problematic or uncertain » (Profit)

### 1.2.5.1 Barrier description

This barrier highlights farmers' uncertainties about the profitability of diversification practices. This barrier was identified in 11 of the 25 case studies.

### 1.2.5.2 Key elements of solutions

Three types of solutions were identified across DiverIMPACTS case studies and experts' knowledge:

a. dealing with the low or uncertain agronomic performance of the new crop; b. relying on the farm-level resilience, and c. relying on innovative value chains (Figure 5).



Figure 5: Key elements of solutions to the Profit Barrier.

The objective of dealing with the low or uncertain agronomic performance of the new crop (a) is detailed in the barrier “Uncert\_Perf” (see below).

The objective of relying on the farm-level resilience (b) can be pursued e.g. through an increase in the total number of crops on the farm, in order to mitigate the risks.

The objective of better organizing downstream steps (c) can be pursued through:

- › The internalization of some of the post-harvest activities (drying, storing, processing...) in order to increase the added value;
- › The setting of fair pricing mechanisms;
- › The elaboration of contracts that take into account the variability of the production while providing sufficient added-value<sup>5</sup>.

It is worth noting that conventional farmers are well-embedded in their production systems and practices within which the use of inputs is central (and thus some of the advantages of crop diversification related to soil fertility are not directly needed). As, for the moment, the price of inputs

<sup>5</sup> In some contexts, contracts with flexible duration are seen as an advantage, while in other contexts they are seen as a limiting factor. Similarly, a flexible pricing system may help to overcome some of the uncertainty related to the profitability of crop diversification products; while in other contexts a fixed price might be preferred. Further research is being undertaken in the context of DiverIMPACTS regarding contracts and pricing mechanisms.

is relatively low, they do not perceive the financial benefit of leaving those practices. With a medium to long term perspective, this context could change with two entry points:

- › *Increase of inputs price*: as diversification practices as less inputs-dependent, they may enable the farmers to save money on the short (less direct expenses) and long term (increase of soils' richness);
- › *Increase of demand*: as sustainable farming systems will be more known and searched for, prices of sustainable products are likely to increase in comparison to conventional agricultural products.

## 1.2.6 Barrier « Uncertainties, risks and variability of agronomic performances » (Uncert\_Perf)

### 1.2.6.1 Barrier description

This barrier highlights farmers' concern about the low agronomic performances of minor crops. It is a transversal barrier found in 10 of the 25 case studies.

### 1.2.6.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a.** dealing with the low or uncertain agronomic performance of the new crop, and **b.** improving the agronomic performance of the new crop (Figure 6).

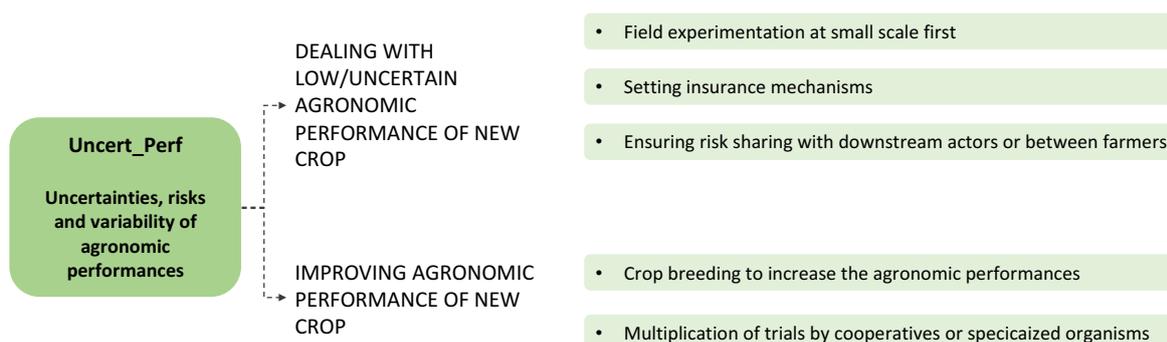


Figure 6 : Key elements of solutions to the Uncert\_Perf barrier

The objective of dealing with the low or uncertain agronomic performance of the new crop (a) can be pursued through<sup>6</sup>:

- › Starting small i.e. undertaking field experiments of the new crops on relatively small areas for the first few years in order to mitigate the risks and assess the crop's performances in diverse climate/year contexts;
- › Developing insurance mechanisms for addressing the risks of crop failure;
- › Mechanisms for sharing the risks associated with the variability of production with downstream actors or within farmers' groups.

Improving the agronomic performance of the new crops (b) can be implemented through:

- › The organization of crop breeding, led by seed providers or by farmers, in order to increase the agronomic performances of crops along the years;
- › More field experiments led by research and technical institutes in order to reduce farmers' misperception of the hazards involved in crop diversification.

<sup>6</sup> These actions also apply to the previous barrier (*Profit*).

## 1.2.7 Barrier « Lack of technical knowledge about the impact on farming system and design » (K\_syst)

### 1.2.7.1 Barrier description

This barrier highlights farmers' lack of knowledge and references about how integrating new crops or practices may have impacts at the farming system level.

This barrier is found in both the 'changing from within' and 'building outside' settings. For some conventional farmers, it is indeed quite challenging to develop systemic thinking of longer rotations, and to integrate into their decision making the idea that one new crop could have positive impacts for several years. In the case of farmers involved in alternative approaches, they are generally more familiar with systemic thinking of more complex rotations, but systemic references are still needed regarding the impacts of including new crops or intercropping in rotations. This barrier was identified in 9 of the 25 case studies.

### 1.2.7.2 Key elements of solutions

Two axis of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing further knowledge and references**, and **b. strengthening accessibility/distribution of knowledge to actors** (Figure 7).



Figure 7: Key elements of solution to the K\_Syst barrier.

The objective of developing further knowledge (a) can be implemented through:

- › Field experiments and research in order to identify efficient "pre-crop/following crop" combinations.
- › Assessing the short-, medium- and long-term impacts of diversification practices on farming systems;
- › Assessing the effects of specific new crops in the context of crop diversification.

The objective of strengthening the accessibility/distribution of knowledge to actors (b) can be pursued through:

- › The development of "peer-to-peer" farmer learning process;
- › Advice and support by trained instructors, enabling farmers to manage their production and reduce their misperception of the hazards involved in the production of diversification crops.

## 1.2.8 Barrier « Lack of information because of problems with advisory context » (Advice)

### 1.2.8.1 Barrier description

This barrier refers to the current advisory context within which most farmers get their technical advice from cooperatives or from traders who both buy their crops and sell them fertilizers and pesticides<sup>7</sup>.

This barrier is encountered in the 'changing from within' setting (i.e. in conventional context), as most agricultural advice given to conventional farmers is delivered by mainstream inputs companies which have no interest or information concerning a multi-year effect of crop diversification. The barrier was identified in 9 of the 25 case studies.

### 1.2.8.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. rethinking the advisory services to farmers**, and **b. diversifying the sources of advice and knowledge** (Figure 8).



Figure 8: Key elements of solutions to the Advice barrier.

The objective of rethinking the advisory services to farmers (a) can be implemented through:

- › The promotion of trainings for farmers to enable them to analyze, assess and take decisions regarding their own practices;
- › The promotion of collective farmers' peer-to-peer or inter-actors learning processes;
- › The development of new advisory services regarding diversification practices (e.g. independent pr public training institutes, technical expert to be hired by farmers, etc.).

The objective of diversifying the sources of advice and knowledge (b) can be pursued through:

- › The identification of other knowledge networks, possibly outside of their region;
- › The development of specific communication on the existence of different advisory organisms.

<sup>7</sup> This situation is also to be linked to the fact that, in most EU contexts, the staff from the pesticides/inputs companies remain the (almost) sole ones to visit the farms and discuss with the farmers.

## 1.2.9 Barrier « Current situation is still profitable on the short term » (Current)

### 1.2.9.1 Barrier description

This barrier refers to the so far profitable situation of conventional farming versus the alternative farming systems based on crop diversification.

This barrier is found in the 'changing from within' setting (i.e. in mainstream context). It is indeed difficult for farmers to perceive the advantages of adopting crop diversification as their situation is still profitable in the short-term in the current economic and regulatory context<sup>8</sup>.

It was identified in 9 of the 25 case studies.

### 1.2.9.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. demonstrating the risks associated with current systems**, and **b. demonstrating the benefits associated with innovative practices** (Figure 9).



Figure 9: Key elements of solutions to the *Current* barrier.

The objective of demonstrating the risks associated with current systems (a) can be implemented through:

- › The identification of agronomic and economic risks of conventional systems on the middle-to-long term (eg. declining yields, sensitivity to droughts or to price variations, etc.) through reviews of the literature, research, fields assessments, etc.
- › A specific communication on those risks to increase awareness among all actors.

The objective of demonstrating the benefits associated with innovative practices (b) can be pursued through:

- › The description of the advantages of the innovative practices for the environment and in terms of added value;
- › The communication of good practices and success stories with qualitative and quantitative results.

A special attention should be paid to the case-by-case application of certain innovations. When promoting innovative practices, each practice should be clearly linked to the type of farmer for whom it is the most efficient.

<sup>8</sup> As mentioned earlier, the low prices of fertilizers and pesticides is a factor to this profitability. The low prices of the inputs are not an incentive to move towards systems with less dependency on external inputs.

## 1.2.10 Barrier « Constraints in labor organization (period, volume), mental or physical load » (Work)

### 1.2.10.1 Barrier description

This barrier highlights farmers' concerns about labor organization and workload linked to diversification practices.

This barrier was encountered in the 'playing horizontal' setting, where managing strips or collaborating with livestock farmers requires a shift in the way of thinking about interactions, either at the plot/farm level or between farms. The barrier also applies to crop diversification in general, as new, additional practices have to be implemented and the farm system has to be re-organized with a larger number of crops to manage. It was identified in 9 of the 25 case studies.

### 1.2.10.2 Key elements of solutions

Three axis of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. adapting the labor force**, **b. reducing workload**, and **c. supporting a change in farmers' habits** (Figure 10).



Figure 10: Key elements of solutions to the Work barrier.

The objective of adapting the labor force (a) can be pursued through:

- › A reorganization of the labor force in order to manage the new pre- and post-crops activities associated with the diversification practices;
- › The hiring of service providers who will take care of some crop management operations;
- › An association with other farmers to hire someone to cover the additional workload.

The objective of reducing the workload (b) can be implemented through:

- › The selection of crops/practices with low work demand and/or crops that allow for the dispersion of the workload over the year.

The objective of supporting a change in farmers' habits (c) can be implemented through:

- › A support to farmers in reshaping their routine and understanding the benefits of diversification over time;
- › Advisory services that put the emphasis on the compensatory 'cost-benefit' effects that farmers can have by adopting diversification crops in the long term.

In general, the additional revenue obtained through the new crops should cover the additional labor cost.

## 1.2.11 Barriers related to the CAP, environmental or sanitary regulations (Reg)

### 1.2.11.1 Barrier description

This barrier highlights farmers' difficulties to adopt innovative diversification practices in the current regulatory context.

Farmers activities are already framed by a large number of regulations. Implementing new, additional farming practices can be perceived as a source of further regulatory constraints. Moreover, the Common Agricultural Policy (CAP) framework implies a significant number of administrative tasks for the declaration of different practices. This barrier is therefore associated with the fear of seeing an increase of the number of rules to be followed, and an increase of the associated administrative workload. It was identified in 9 of the 25 case studies.

### 1.2.11.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. developing a supporting policy framework and b. adapting advisory services (Figure 11).



Figure 11: Key elements of solutions to the Reg barrier.

The objective of developing a supporting policy framework (a) can be pursued through:

- › The recognition and promotion of environmental benefits of diversification practices, in order to compensate the time to be spent on extra administrative tasks;
- › The simplification of CAP paperworks in order to limit the regulative and administrative barriers.

The objective of adapted advisory services (b) can be pursued through:

- › The development of documentation about the regulation and how they apply to diversification crops;
- › A focus from the advisory organisms on the clarification of which regulation to apply and how.
- › See also solutions identified to the *Syst* barrier.

## 1.2.12 Barrier « Lack of adapted plant varieties in the local context » (Varieties)

### 1.2.12.1 Barrier description

This barrier highlights the lack of varieties of minor crops adapted to local conditions.

It is a transversal barrier. It was identified in 8 of the 25 case studies.

### 1.2.12.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge:

a. **developing further knowledge**, and b. **facilitating access to known varieties** (Figure 12).

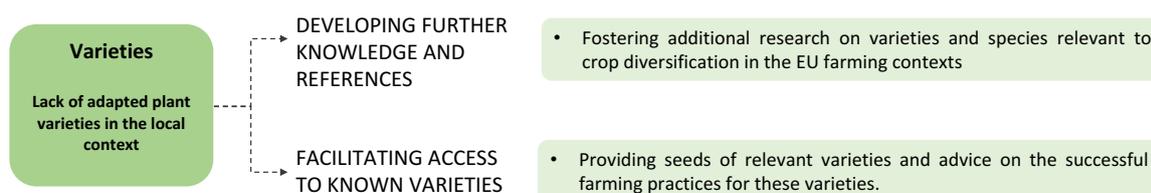


Figure 12: Key elements of solutions to the *Varieties* barrier.

The objective of developing further knowledge (a) can be pursued through additional research to find varieties best adapted to different contexts.

The objective of facilitating access to already known varieties (b) can be supported by inputs providers and advisory organisations, which can provide seeds adapted to the local context and inform farmers about varieties and farming practices.

The development of diversification practices will highly benefit from a greater knowledge about the adapted varieties and species.

## 1.2.13 Barrier « Need of innovation in machinery for field activities » (Machin\_Innov)

### 1.2.13.1 Barrier description

This barrier highlights the need for farmers to access innovative machinery adapted to crop diversification.

Contrary to the Machin\_Invest barrier, Machin\_Innov has an impact in the 'changing from within' setting. Indeed, barriers related to farm machinery in the conventional context are presented more as a question of innovation than as a problem of investment.

This barrier was identified in 8 of the 25 case studies.

### 1.2.13.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge:

a. **co-adapting the crop diversification systems and the existing machinery**, and b. **developing a supporting context** (Figure 13).



**Figure 13: Key elements of solutions to the *Machin\_Innov* barrier.**

The strategy of finding ways to make new crops and the existing machinery fit together (a) can be pursued through:

- › Adaptation of existing machines to suit the new crop and new practices;
- › Choice of the crops and practices in consistency with existing machines (if feasible) and possibilities of on-farm innovation.

The objective of developing a supportive context (b) could be implemented through:

- › The identification of the specific machinery needs related to crop diversification<sup>9</sup>;
- › An active communication towards machinery providers about the innovative machinery needed for crop diversification;
- › Supporting farmers-to-farmers' knowledge and skills sharing about on-farm innovation;
- › Supporting the R&D and marketing of innovative equipment suited for crop diversification.

It is worth noting that a large range of machinery is already existing, and part of the existing machines could be adapted to diversification practices. Moreover, it is needless to say that if the demand were to increase for specific machinery, offer and supply will follow. The industrial sector could therefore play a leading role in overcoming this barrier.

<sup>9</sup> DiverIMPACTS' D5.4 will provide an assessment of the needs in terms of machinery and guidelines.

## 1.2.14 Barrier « Low agronomic performances (yield, quality) » (Perf)

### 1.2.14.1 Barrier description

This barrier highlights the difficulties that farmers might encounter due to the low agronomic performances of innovative crops. It was identified in 8 of the 25 case studies.

### 1.2.14.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. **developing further knowledge and references**, and b. **ensuring adequate pricing of cultivated crops** (Figure 14)



Figure 14: Key elements of solutions to the *Perf* barrier.

The objective of developing further knowledge and references about the crops' performance (a) can be implemented through:

- › Identification of the factors impacting crops performance, in terms of yield and quality, through agronomic research and on-farm assessment;
- › Evaluation of the performance of crops based on economic, social and environmental cost-benefit methods.

The objective of ensuring adequate pricing of new crops (b) can be pursued through:

- › Designing contracts with prices adapted to the crop performance to ensure profitability<sup>10</sup>;
- › Setting insurances mechanisms to help overcome low yield situations.

## 1.2.15 Barrier « Increased complexity for management and decision-making » (Complex)

### 1.2.15.1 Barrier description

This barrier highlights farmers' fear or actual challenge of increased complexity when dealing with crop diversification.

It is a transversal barrier affecting both conventional and organic systems, as well as the horizontal interactions between farmers. Any change to practices can be perceived as source of complexities and new challenges. It was identified in 8 of the 25 case studies.

<sup>10</sup> DiverIMPACTS' D5.6 will provide insights on contracts design in favor of crop diversification.

### 1.2.15.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. managing complexity**, and **b. adapting advisory services** (Figure 15).



Figure 15: Key elements of solutions to the *Complex* barrier.

The objective of managing complexity (a) can be pursued through:

- › The development of adapted management tools that take into account diversification practices;
- › Setting advantages to the diversification products (e.g. higher added-value, etc.) in order to compensate the increase in complexity.

The objective of developing advisory services (b) can be pursued through:

- › See “Advice” barrier (*Rethinking the advisory services to farmers*).

## 1.2.16 Barriers « Cognitive frame and ways of thinking to be changed » (Cogni) & « Cultural barriers, confrontation with practices of parent's generation » (Trad)

### 1.2.16.1 Barriers description

These two barriers highlight the necessity for, and the difficulties arising from, the changes in farmers' ways of thinking about their farming system and activity. The transition to innovative practices requires cognitive changes.

The “Cogni” barrier refers to the existing cognitive barriers inherent to each individual or communities when faced with change. This cognitive framework can be understood as a complex mix of values, beliefs and perception of risks among other things, that guide one's individual perception, thoughts and actions. When studying cognitive framework, it is crucial to consider the potential influence of one's social environment to understand its barriers to change. This influence may reveal to be even stronger in a sector of tradition and heritage as the agricultural sector.

The “Trad” barrier highlights the difficulty often encountered in farming systems that the farm and farming practices are usually inherited from a parent. Within this configuration any change can be perceived as a critic or a reassessment of what has been done so far. Multi-generation farms testify of the existence of conflicts of vision between generations.

These barriers are encountered in the “playing horizontal” ideal-type (i.e. at the farm level) where progressive change is certainly a source of questions and misperception from neighbours and potentially from individuals on the farm. It was identified in 6 of the 25 case studies.

### 1.2.16.2 Key elements of solutions

The modification of cognitive frames and ways of thinking depends on a multitude of factors. It would be tricky to establish a list of tasks and actions to implement as performed with the other barriers. Some of the responses brought by DiverIMPACTS case studies and experts' knowledge imply a progressive resolution of this barrier through time: either through changes brought when a new associate takes over the farm with new ideas, skills, funding, etc., or when a new generation comes in with an interest and awareness of the potential benefits of a change of practices. Additionally, a solution raised was the stimulation of farmers' interest in innovative practices (Figure 16).



Figure 16: Key elements of solutions to the *Cogni* and *Trad* barrier.

This can be pursued through:

- Reducing the misperception of the hazards and challenges involved in the production of diversification crops through advisory, documentation, etc.;
- The integration of alternative farming systems and diversification practices in training and educational programs;
- The development of specific advisory services addressing the *Cogni* and *Trad* barriers.

### 1.2.17 Barrier « Seeds are hard or expensive to get » (Seeds)

#### 1.2.17.1 Barrier description

This barrier highlights the lack of access to seeds of minor crops adapted to a diversity of local conditions. It was identified in 5 of the 25 case studies.

#### 1.2.17.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. reducing seeds supply cost**, and **b. facilitating access to seeds** (Figure 17). These solutions apply both to conventional and organic farming contexts.



Figure 17: Key elements of solutions to the *Seeds* barrier.

The objective of reducing seeds' supply cost (a) can be implemented through:

- › Collective purchase of larger volume of seeds by farmers' groups or cooperatives;
- › Fostering exchanges of farmer-saved seeds within farmers' networks<sup>11</sup>;
- › Assessing the profitability by comparing the seeds costs with the total crop added value.

The objective of facilitating the access to seeds (b) can be pursued through:

- › Providing information on the existing seeds supply options;
- › Supporting the development of seeds supply.

## 1.2.18 Barrier « Farmers' lack of awareness about issues linked to specialization » (Awar\_Farm)

### 1.2.18.1 Barrier description

This barrier refers to farmers lack of awareness about issues linked to simplified/specialized farming systems.

This barrier is found in the 'changing from within' setting, in which farmers are generally not well aware or convinced of sustainability issues around simplified farming systems, or of the benefits they could derive from crop diversification. On the contrary, farmers involved in alternative approaches, such as in the 'building outside' setting, are generally well aware and convinced of the benefits of crop diversification.

It was identified in 5 of the 25 case studies.

### 1.2.18.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. communicating on the issues, and b. demonstrating the benefits of the change (Figure 18).



Figure 18: Key elements of solutions to the *Awar\_Farm* barrier.

The objective of communicating on the issues (a) can be implemented through:

- › Identifying the systemic nature of the problems in the farming system;
- › Undertaking multi-criteria evaluation to assess performance according to the economic, social and environmental cost-benefit aspects.

The objective of demonstrating the benefits of a shift towards diversified systems (b) can be pursued through:

<sup>11</sup> Farmer-saved seeds are indeed common for diversification crops (often multiplied from the small area where the crop was tested the first year).

- › Promoting farming systems involving crop diversification that proved to be profitable;
- › Fostering “peer-to-peer” farmers’ exchanges about knowledge and practical experience.

## 1.2.19 Barrier « Lack of available or adapted phytosanitary solutions » (Phyto)

### 1.2.19.1 Barrier description

This barrier highlights farmers’ concern about the fact that for some new crops, no satisfactory crop protection solutions based on pesticides exist. Such concern arises in the “changing from within” setting involving conventional farmers. This barrier was identified in 3 of the 25 case studies.

### 1.2.19.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts’ knowledge: **a. developing crop protection alternatives** and **b. mitigating performance loss**.

The objective of developing crop protection alternatives (a) can be implemented through:

- › Experimenting alternative strategies that require less or no use of phytosanitary products (see e.g. intercropping advantages, integrated pest management, etc.);
- › Encouraging research on new bio-products to protect crops;
- › Encouraging further R&D on sustainable mechanical weeding.

The objective of mitigating performance loss (b) can be pursued through the compensation of yield loss with adapted sale price (see contracts options described to address other barriers).



Figure 19: Key elements of solutions to the *Phyto* barrier.

## 1.3 Solutions for addressing barriers at the downstream operations level

A total of 12 barriers were identified at the downstream operation level (Morel *et al.* 2020). Various barriers relate to the need for further innovation towards equipment that is adapted for processing new crops, and the challenges to fund related investments (Table 1).

### 1.3.1 Barrier “Volumes are too limited in a given area to be profitably or easily collected” (Coll\_Vol)

#### 1.3.1.1 Barrier description

This barrier highlights the inadequacy of existing large-scale systems for collecting and marketing and small volumes produced through the diversification process. The size and specialization of large scale collection systems make them reluctant to collect and store small volumes of (new) crops that innovative farmers may test or seek to develop.

This barrier was identified in 16 of the 25 case studies.

### 1.3.1.2 Key elements of solution

Three main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. **organizing and increasing the production**, b. **re-organizing the collection** and c. **securing long-term commercial relationships** (Figure 20). These solutions apply both to conventional and organic farming contexts.



Figure 20: Key elements of solutions for *Coll\_Vol* barrier.

The objective of securing and organizing the production (a) can be implemented through:

- › A well thought geographic repartition of the minor crops to ensure that the production of a given crop is centralized enough;
- › An increase in the number of farmers and of the surface of land dedicated to the new crops.

The objective of re-organizing the crop collection (b) can be implemented through:

- › Supporting farmers' groups in developing small-scale collection and storage capacities;
- › Supporting/relying on other actors who can collect and trade or process small volumes, or collect sufficient volumes through finding sufficient farmers/area of production.

Finally, the objective of securing long-term commercial relationships (c) can be pursued through:

- › The setting up of contracts with grouped commitment of farmers to increase the crop acreage along years (better anticipation of the volumes produced).

A special attention should be paid to the terms of the contracts. Some stakeholders (but not all) underline the necessity of establishing clear contracts in advance, based on fair and transparent prices, and on quantity and quality criteria that cover production and operational costs at all levels of value-chains. Another key aspect in the contracts is to well determine who will be in charge of the storage and transport of the production as losses always happen in those steps and some contracts could put the burden of those activities on the farmers group.

## 1.3.2 Barrier “Equipment for screening, cleaning, drying or storing requires investment” (Pre\_ProInvest)

### 1.3.2.1 Barrier description

This barrier highlights the fact that the equipment for processing new types of crops requires investments.

If the farmers are developing niche products, the post-harvest steps require a range of equipment which may only be needed for small and irregular volumes of products. The burden of the investment can represent an important barrier.

It is a transversal barrier found both in the 'changing from within' as well as in the 'building outside the regime' setting (i.e. in conventional and organic farming contexts). It was identified in 11 of the 25 case studies.

### 1.3.2.2 Key elements of solution

Two types of solutions that were identified across DiverIMPACTS case studies and experts' knowledge for making the investment profitable or a non-limiting factor: **a. increasing and diversifying the production** and **b. securing the profitability of the equipment** (Figure 21).

The objective of increasing and diversifying the production (a) can be reached through:

- › An increase in the volume of the crop to be processed;
- › An increase in the number of crops that can be processed with the new equipment.

The objective of securing the profitability of the equipment (b) can be pursued through:

- › Selling processing services to other actors if the equipment is not used at 100% of its capacity;
- › Gathering farmers for collective investment and use;
- › Providing financial support for the purchase of equipment for crop diversification;
- › Contracts for the processed products for securing long term market opportunities;
- › Technical innovation for adding value to the product.



Figure 21: Key elements of solution for *Pre\_ProInvest* barrier.

### 1.3.3 Barrier “Equipment for processing requires investment” (Process\_Invest)

#### 1.3.3.1 Barrier description

It is a transversal barrier found across the three innovation settings, in 11 of the 25 case studies. It applies differently in small-scale and mainstream value chains.

In mainstream value chains, the challenge is to secure sufficient volumes for rendering large-scale processing units profitable.

In niche value chains, the main obstacle is to ensure a certain profitability of the investment while the volume of production may be small. (Another obstacle is the identification of appropriate equipment).

### 1.3.3.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. limiting the cost of the investment and b. securing the profitability of the equipment (Figure 22).

The objective of limiting the cost of investment (a) can be implemented through:

- For niche value chains, the collective purchase of processing installation is identified as a good way to have an appropriate sizing of the equipment for the amount of products, and thus reaching higher profitability (in regard to the cost/benefit ratio).
- The collective purchase may also allow sharing the organizational and technical skills that would otherwise have to be endorsed by one farm only.

The objective of securing the profitability of the equipment (b) can be pursued through:

- The investment in processing equipment may lead to obtaining contracts that would not be accessible otherwise: the equipment enables new marketing opportunities.
- Attention should be given to the possibility of increasing the number of crops that could be concerned by the new investments.
- The processing services could be sold to other actors if the equipment is not already used at 100% of its capacity;
- The incentive for investment on both sides of the value chain should be guaranteed by a pricing system that ensures a sufficient return on investment for stakeholders.

It is important to note that using a new processing equipment requires the development of new skills as well as extra workload. Those aspects of time and skills should be considered and taken into account in the contracts and pricing mechanisms.



Figure 22: Key elements of solutions to the *Process\_Invest* barrier.

### 1.3.4 Barrier “Competition on the global market with crops produced cheaper elsewhere (for processors or retailers)” (Compet)

#### 1.3.4.1 Barrier description

This barrier highlights the fact that competition is an important limiting factor for diversification. This has proven to be especially present in the composition of feed products where the price of substitutable ingredients on the global market is a dominant criterion, but also in local quality-oriented markets. As new crops often compete on the global market with other or similar crops that

can be produced cheaper elsewhere, it is therefore crucial to guarantee a secure outlet in the future to encourage farmers to “invest in a new crop”.

This barrier was identified in 9 of the 25 case studies.

#### 1.3.4.2 Key Elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. differentiating the products** and **b. securing the demand** (Figure 23).



Figure 23: Key elements of solution to the *Compet* barrier.

The objective of differentiating the products (a) can be achieved through:

- › Developing specific, high added-value products obtained through crop diversification;
- › Communicating on the specificities of the product (its origin, production system, etc.) e.g. through labels.

The objective of securing the demand (b) can be pursued through:

- › Securing the market through vertical integration or through contracts with downstream actors;
- › Prospecting for niche markets with high added value (e.g. vegetable proteins or foods rich in Omega).
- › Managing the price gap between products obtained from crop diversification, high sustainability standards agriculture versus products coming from countries with very low standards (e.g. with an import tax);
- › Promoting products from crop diversification in catering.

### 1.3.5 Barrier “Equipment for separation of crops requires investment” (Separ\_Invest)

#### 1.3.5.1 Barrier description

This barrier highlights the difficulty of funding adequate equipment to ensure the separation of crops obtained through intercropping. The barrier was identified in 8 of the 25 case studies.

#### 1.3.5.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge for addressing the investment challenges: **a. increasing and diversifying the production** and **b. securing the profitability of the equipment** (Figure 24).

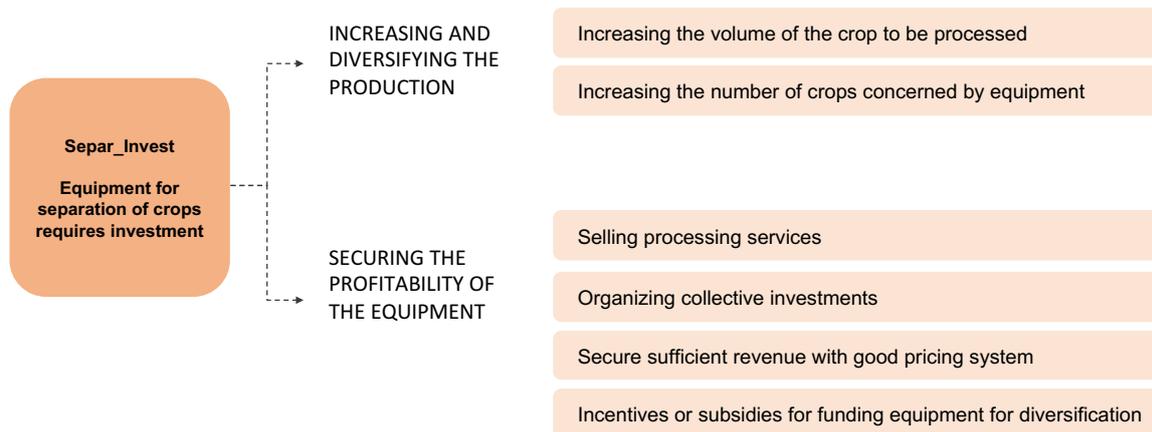


Figure 24: Key elements of solution for the *Separ\_Invest* barrier.

The objective of increasing and diversifying the production (a) can be implemented through:

- › An increase in the volume of the crop to be processed;
- › An increase in the number of crops and volumes concerned by the new equipment.

The objective of securing the profitability of the equipment (b) can be pursued through:

- › Selling services to other actors if the equipment is not already used at 100% of its capacity;
- › Gathering farmers interested in the equipment to invest collectively;
- › The incentive for investment on both sides of the value chain should be guaranteed by a pricing system that ensures a sufficient return on investment for stakeholders.
- › The new Green Deal could provide incentives or subsidies for new equipment dedicated to diversification.

### 1.3.6 Barrier “Equipment for processing requires innovation” (Process\_Innov), “Equipment for cleaning, drying or storing requires innovation” (Pre\_ProInnov) & Barrier “Separation of crops requires innovation” (Separ\_Innov)

#### 1.3.6.1 Barrier description

This barrier highlights the fact that the post-harvest management (screening, cleaning, drying, storing) and processing of new crops require innovations for the value chains to develop.

#### 1.3.6.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing partnership within the value chain**, and **b. securing the profitability of the innovation** (Figure 25).



Figure 25: Key elements of solution for the *Process\_Innov*, *Pre\_Pro\_Innov* and *Separ\_Innov* barriers.

The strategic axis of developing partnership with actors of the chain (a) can be implemented through:

- › Partnerships at the value chain level to co-adapt the processing (e.g. compromise on a variety that is both adapted to the local context of crop diversification and adapted to the processing);
- › Partnerships of several processing actors (on farm or downstream actors) for collective innovation in terms of equipment.

The objective of securing the profitability of the innovation (b) can be pursued with:

- › Incentives and/or pricing system that ensures a sufficient return on investment for stakeholders involved in the innovation process.

### 1.3.7 Barrier “Regulations issues around sanitary, quality and purity aspects” (Qualsan)

#### 1.3.7.1 Barrier description

While regulations around sanitary, quality and purity aspects ensure high quality standards of the production, these regulations may be a limiting factor for innovation as they require a significant attention, time and equipment.

It is a transversal barrier that is encountered at the farm level as well as in niches and mainstream value chains. It was identified in 5 of the 25 case studies.

#### 1.3.7.2 Key elements of solution

Two types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. making current regulation more supportive to crop diversification** and **b. developing specific regulations that support crop diversification** (Figure 26).

Making current regulation more supportive to crop diversification (a) can be achieved through:

- › Providing administrative support to actors undertaking diversification on regulatory aspects;
- › Providing subsidies to actors undertaking crop diversification for addressing regulatory and quality aspects;
- › Circulate information to the consumers about the high-quality standards of EU products as ensured by the regulatory frameworks (in contrast to possibly lower standards of imported products).

The idea of specific regulations supporting crop diversification (b) can be illustrated as below:

- › Develop specific HACCP/certification procedures facilitating the adoption of crop diversification techniques by farmers and processors and guaranteeing the safety of the alternative products.

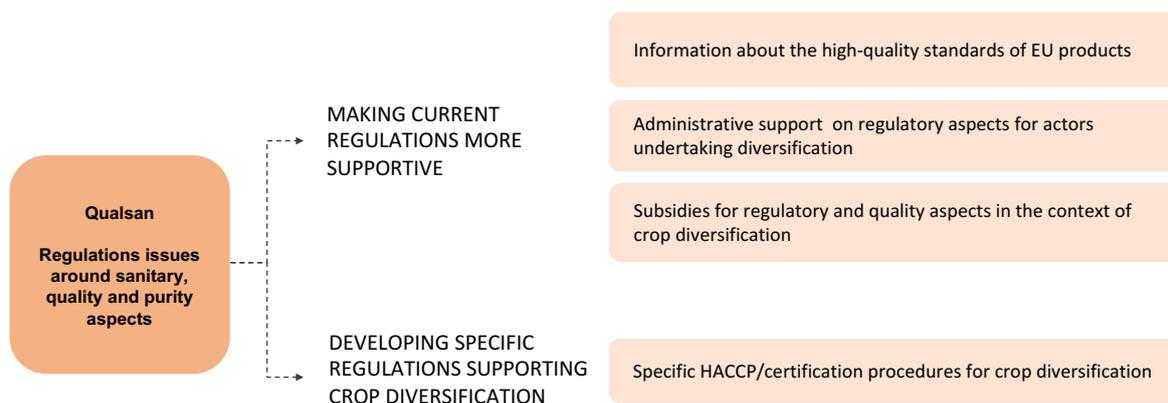


Figure 26: Key elements of solution for the *Qualsan* barrier.

### 1.3.8 Barrier “Administrative, fiscal or accounting issues” (Admin)

#### 1.3.8.1 Barrier description

This barrier highlights the fact that administrative and fiscal and issues may come in the way of developing new market circuits and contracts.

As an example, in the context of strip cropping (one strategy of crop diversification), It is often reported that official declaration of strips in the dedicated software to obtain public subsidies (CAP) is a brain teaser, because such software usually allows only one crop per field.

On the fiscal aspect, contracting directly between farmers for selling crops (a relevant strategy in the context of crop diversification) is highly complex in some countries from a tax perspective, especially for big volumes. It sometimes requires the support of an, often reluctant, intermediary (such as a cooperative) which is officially allowed to collect taxes for the state, whereas farmers would like to interact directly between themselves.

This barrier was identified in 4 of the 25 case studies.

#### 1.3.8.2 Key elements of solution

One main axis of solutions was identified across DiverIMPACTS case studies and experts' knowledge: **adapting the administrative and fiscal practices** (Figure 27).



Figure 27: Key elements of solutions to the *Admin* barrier.

The objective of adapting the administrative and fiscal practices could take the form of:

- A simplification of the administrative paperwork to access subsidies;

- › A higher flexibility of the administrative tools of the CAP, especially in regard to diversification practices (e.g. taking into account strip cropping);
- › The development of fiscal entities that facilitate the transaction of crops or use of lands between farmers (to be explored by farmers' unions or groups of farmers).

### 1.3.9 Barrier “Traders are reluctant to support solutions which may reduce inputs that they sell” (Input)

#### 1.3.9.1 Barrier description

This barrier highlights the fact that, in commodity value-chains, traders who buy the crop production are also the main providers of technical and agronomic advice<sup>12</sup> and farming inputs (fertilizers, pesticide, seeds, etc.). As crop diversification could reduce the dependency on external inputs and decrease the production volumes for main crops, these players have no interest in promoting it. This barrier is present in the “Changing from within” context i.e. mainstream value chains. It was identified in 3 of the 25 case studies.

#### 1.3.9.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing more autonomy from the traders** and **b. promoting a supportive regulatory context** (Figure 28).

The objective of having more autonomy from the traders (**a**) can be developed through:

- › In cases where the inputs traders are also the crop buyers, the creation of alternative value chains by farmers for marketing their products, independently from inputs providers;
- › Diversifying the marketing options (multiple contracts between the farmer and downstream actors), leading to less dependency on one trading/downstream actor.

Examples of actions for developing a supportive regulatory context (**b**) include:

- › Making advisory and the provision of services/inputs separated;
- › Increasing the tax to be applied on farming inputs (fertilizers and pesticides); while
- › Offering specific subsidies related to crop diversification ecosystem services.

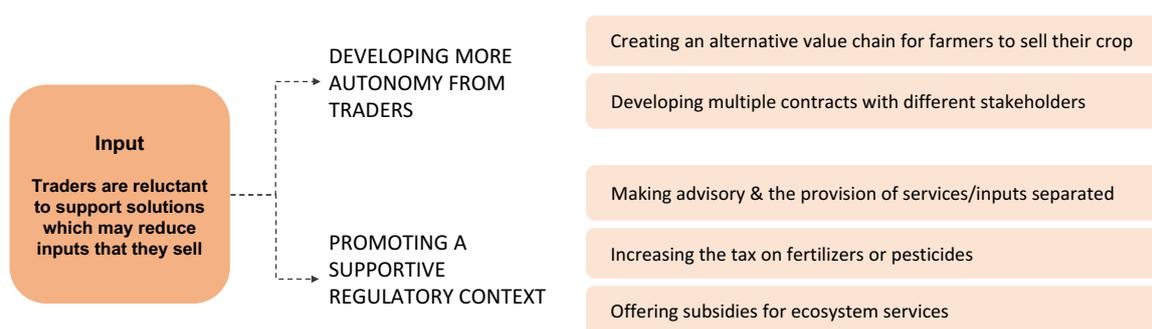


Figure 28: Key elements of solutions for the *Input* barrier.

<sup>12</sup> This has to be considered in parallel with the previously mentioned lack of independent technical advisory bodies and the fact that the traders or representatives of inputs companies often are the main actors going on the farms and having direct interactions with the farmers (see barrier *Advice*).

### 1.3.10 Barrier “Dealing with diversification products brings higher costs” (Cost)

#### 1.3.10.1 Barrier description

This barrier highlights the fact that when diversifying cropping systems, farmers and downstream actors have to deal with smaller volumes, sometimes atypical products (new crop or new variety) and with a more variable quality and quantity than those found in commodity value chains. In addition to specific investment needs (see equipment barriers described above), these aspects may lead to higher costs for storing and processing the crop production, and the economies of scale are not so high than for large-scale production. This barrier was identified in 3 of the 25 case studies.

#### 1.3.10.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. sharing the costs between actors of the value chain** and **b. securing the demand** (Figure 29).

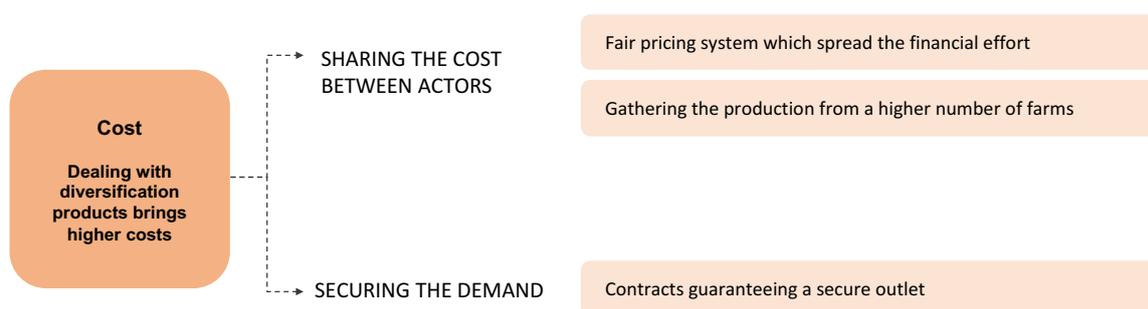


Figure 29: Key elements of solution for the *Cost* barrier.

The objective of sharing the additional costs between actors (**a**) can be implemented by:

- › A fair pricing system which spreads the financial effort across the value chain;
- › Gathering the production from a higher number of farms.

The objective of securing the demand (**b**) can be pursued with, e.g.:

- › Contracts guaranteeing a secure outlet in the future. This is crucial to encourage farmers and downstream actors to “invest in a new crop”.

## 1.4 Solutions for addressing barriers at the market level

A total of four barriers were identified at the market level (Morel *et al*, 2020) (Table 1).

### 1.4.1 Barrier “Need to raise consumers’ awareness about diversification benefits”

#### 1.4.1.1 Barrier description (Awar\_Comm)

Explaining to consumers why crop diversification strategies are beneficial to the environment is a challenge. This is illustrated by the fact that farmers who practice strip cropping prefer to communicate on the positive visual impact of strips in terms of landscape than in terms of their agronomic advantage. This barrier was identified in 17 of the 25 case studies.

#### 1.4.1.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts’ knowledge: **a. differentiating the products** and **b. improving communication towards consumers** (Figure 30).



Figure 30: Key elements of solution for *Awar\_Consum* barrier.

The objective of differentiating the products (a) can be implemented through:

- › A labelling of products/farming systems that provide ecosystem services;
- › An increase in price to valorise the environmental benefits coming from crop diversification.

The objective of improving communication towards consumers (b), can be pursued through:

- › Communication campaigns on diversification systems and products;
- › Information and sensitization on the benefits of diversification for the environment;
- › Communicating on health benefits (plant-based proteins, fibres, omega 3...)<sup>13</sup>.

These campaigns could be funded either by taxpayers, farmers or/and downstream actors<sup>14</sup>. They could be undertaken in the mainstream medias, catering contexts<sup>15</sup>, etc. There is a variety of options regarding the specific contents of such communication campaigns, focusing on the health benefits of new crops<sup>16</sup>, agronomic and environmental benefits of diversification practices, etc. A special attention should be paid to not overload the consumers with information.

<sup>13</sup> E.g. in public nutritional recommendations.

<sup>14</sup> An example is the US Marketing Orders, to be related to specific crops.

<sup>15</sup> E.g. in school catering, special meals made with local crops and alternative legume and cereals could be regularly organized.

<sup>16</sup> In France, the National Program for Nutrition and Health insists on legumes and the vegetal balance in diets (Programme National Nutrition Santé 2019-2023, Ministère français des Solidarités et de la Santé. Available online: [https://solidarites-sante.gouv.fr/IMG/pdf/pnns4\\_2019-2023.pdf](https://solidarites-sante.gouv.fr/IMG/pdf/pnns4_2019-2023.pdf)).

## 1.4.2 Barrier “Uncertain or unstable market” (Uncert\_Mark)

### 1.4.2.1 Barrier description

This barrier highlights that markets for diversification products remain uncertain or unstable. A key factor for price and market instability is the competition with imported products, sometimes cheaper, that may discourage farmers or downstream actors to invest in new crops and value chains.

This barrier is particularly encountered in the innovative systems and value chains (“Building outside the regime”): actors who base their system on diversification products could indeed be heavily fragilized by the instability or absence of market. This barrier was present in 14 of the 25 case studies.

### 1.4.2.2 Key elements of solution

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. managing the offer** and **b. securing the demand** (Figure 31).



Figure 31: Key elements of solutions to *Uncert\_Mark* barrier.

The objective of better managing the offer (a) can be pursued through:

- › Adjusting the annual production volume to the demand volume;
- › Managing stocks from one year to another to smooth the demand variability.

The objective of securing the demand (b) can be pursued through:

- › Contracts between value chain actors, ensuring stable market for farmers and stable supply for downstream actors<sup>17</sup>;
- › Partnerships between processing companies and companies able to market the products<sup>18</sup>;
- › Promotion of crop diversification and related products as a key driver for improving environmental footprints.

## 1.4.3 Barrier “No pre-existing or very limited market” (Exist\_Mark)

### 1.4.3.1 Barrier description

This barrier highlights the fact that the absence or the existence of a very limited market for diversification products limits the eagerness of undertaking crop diversification at the farm level as

<sup>17</sup> Options for innovative contract design are being studied in the context of DiverIMPACTS' 5.4 task. For example, contract prices could be defined with (1) a minimum price level and (2) an additional, flexible amount, depending on the current crop prices. Contracts should take into account the specific yield, quality and price/market risks.

<sup>18</sup> Existing examples: wheat from innovative cropping systems using less fertilizers; legumes for animal feed companies (ex. milk producer such as Danone)

well as creating the downstream value chain. Moreover, this implies that there is, so far, a lack of coordination, logistics and suitable contracts practices between the chain actors. As mentioned before, this barrier is interrelated to the barrier of the reduced consumers' awareness around issues related to crop diversification. Developing adequate communication for the different sectors of the value chain could be a key step.

This barrier is encountered in particular in the “Changing from within” ideal type. Considering their mainstream practices and usual market opportunities, the market for diversification products may appear as blurry or non-existent according to their standards. It was identified in 13 of the 25 case studies.

### 1.4.3.2 Key elements of solution

Two main axis of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing the market** and **b. securing the demand for crop diversification products** (Figure 32).

The objective of developing the offer (a) can be achieved through:

- › The development of new products (e.g. pasta made with hemp, lentils, etc.);
- › A progressive increase of the volumes produced.

The objective of securing the demand (b) can be pursued through:

- › The launch of generic advertising campaigns;
- › The use of new crops as a substitute for mainstream crops in existing processing chains;
- › The assessment of the demand and the possibility to adapt the final product accordingly;
- › Growing the niche markets.



Figure 32: Key elements of solution to the *Exist\_Mark* barrier.

## 1.4.4 Barrier “Doubts about willingness of consumers to pay more for diversification products” (Willing)

### 1.4.4.1 Barrier description

This barrier highlights the fact that many doubts are expressed about consumers' willingness to pay (WTP) more for new differentiated products. The difficulty to communicate about the benefits of diversification practices is being considered as a main challenge for the different actors of the chain.

This barrier was identified in 9 of the 25 case studies.

### 1.4.4.2 Key elements of solution

Three main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. differentiating the products and improving communication towards consumers**, and **b. developing a supportive policy framework** (Figure 33).



Figure 33: Key elements of solution to the *Willing* barrier.

The objective of differentiating the products and improving communication towards consumers (a) can be achieved through:

- › Communication campaigns (e.g. generic advertisement) about the benefits of crop diversification for the environment and for human health (e.g. dietary fibres, omega 3, etc.);
- › Promotion of new products (pastas, meat substitutes made with legumes and vegetables) with generic advertising.
- › Labelling the products<sup>19</sup>.

The objective of developing a supporting policy framework (b) can be composed of:

- › Subsidizing food products obtained through crop diversification: as consumers' WTP is limited, public regulation may play a role<sup>20</sup>.

## 1.5 Solutions for addressing barriers at the coordination level

A total of ten barriers were identified at the coordination level (Morel, et al, 2020) (Table 1).

### 1.5.1 Barrier « No ensured and/or fair sharing of added value between actors »

#### 1.5.1.1 Barrier description (Price)

This barrier highlights the necessity of establishing clear contracts in advance, based on fair and transparent prices that cover production and operational costs at all levels of value chains.

This barrier affects in particular the 'building outside' regime, and secondarily the mainstream value chains. The absence of this barrier in the 'playing horizontal' setting is explained by the fact that farmers deal directly with one another or with their usual trade partners, fair and ensured pricing is therefore not a concern.

This barrier was identified in 17 of the 25 case studies.

<sup>19</sup> Labelling can be done either with existing labels or new labels. While new labels may lead to an overload of information to the consumers, existing labels (such as the organic agriculture label) already are well known by consumers.

<sup>20</sup> An option to finance these subsidies could be a tax on polluting/classical foods or with a tax on animal-based proteins.

### 1.5.1.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. differentiating the products, and b. developing innovative value chains (Figure 34).



Figure 34: Key elements of solution to the *Price* barrier.

The objective of differentiating the products (a) can be reached through:

- › The development of a label that guarantees a fair distribution of the added value along the value chain.

The objective of developing innovative value chains with innovative, fair commercial standards (b) can be pursued through:

- › Contracts based on transparency along the supply chain to ensure fair pricing and a sufficient profitability for every actor of the chain;
- › Vertically integrated value chains developed with a specific objective of fair price and fair share of risks.

## 1.5.2 Barrier « No ensured or limited volumes to buy/sell products or establish secure contracts » (Quant)

### 1.5.2.1 Barrier description

This barrier underlines the difficulty of establishing contracts when the farmer can only guarantee a limited volume of production or is confronted with unplanned default of production.

It is especially found in the 'building outside' setting where farmers work with small volumes of products which are generally atypical and more variable in quality than those found in commodity value chains. The absence of this barrier in the 'playing horizontal' setting is explained by the fact that farmers deal directly with one another or with their usual trade partners, quantities are therefore not a concern in the contracts. This barrier was identified in 12 of the 25 case studies.

### 1.5.2.2 Key elements of solutions

Three types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. securing the offer and b. securing the demand (Figure 35).

The objective of securing the offer (a) can be implemented through:

- › Calling on a value chain intermediary who can centralize farmers' production according to the supply needs of the processing industry;
- › A progressive increase of the volume of diversification products;
- › The grouping of farmers who implement diversification practices to reach a critical volume of products to be sold;
- › Cooperation and knowledge sharing in order to make crop diversification easier.

The objective of securing the demand (b) can be pursued through:

- › Setting contracts with a certain flexibility on the quantity and quality allowing contracts' adaptations depending on the profitability for farmers during the innovation process.



Figure 35: Key elements of solutions to the *Quant* barrier.

### 1.5.3 Barrier « Duration of contracts not enough to secure farmers in taking risks and investing » (*Dura*)

#### 1.5.3.1 Barrier description

This barrier highlights the difficulties linked to contracts' duration and related insecurities.

It is found in particular in the 'changing from within' context, in which the difficulty to build multi-year contracts can impede the integration of a new crop which requires financial and personal investment (information, energy, time). The absence of this barrier in the 'playing horizontal' setting is explained by the fact that farmers deal directly with one another or with their usual trade partners, durations are therefore not a concern in the contracts. This barrier was identified in 10 of the 25 case studies.

#### 1.5.3.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. limiting the investment costs, and b. securing the demand (Figure 36).

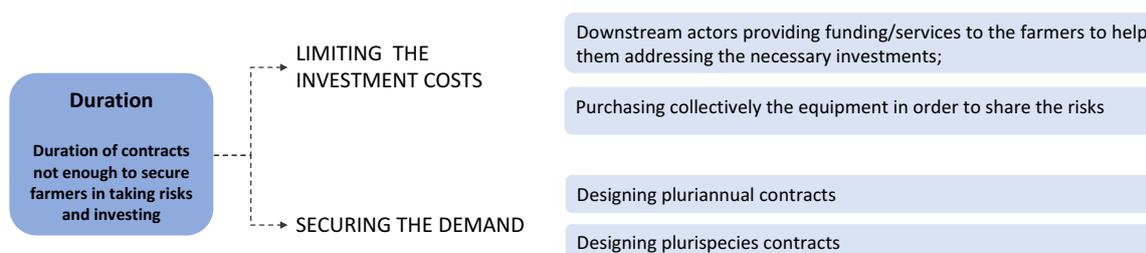


Figure 36: Key elements of solutions to the *Duration* barrier.

The objective of limiting the investment costs (a) can be implemented through:

- › Downstream actors providing funding/services to the farmers to help them addressing the necessary investments;
- › Purchasing collectively the equipment in order to share the risks.

The objective of securing the demand (b) can be pursued through:

- › Designing pluriannual contracts covering at least 3 years and with exit options for farmers;
- › Designing contracts that cover several crop species.

## 1.5.4 Barrier « Limited or no cooperation between innovative farmers » (Orga) & Barrier « Individualistic mentality and lack of trust between farmers limit collective action » (Indiv)

### 1.5.4.1 Barriers description

These barriers highlight the limited practice of cooperation between farmers and the individual mindset that ban them from organizing collectively and providing together enough volumes to mitigate the collection and management costs of alternative crops.

It is found in particular in the ‘changing from within’ setting, where farmers work with large and highly specialized mainstream cooperatives or traders that often are reluctant to collect and store small volumes of new crops. On the other side, farmers innovating outside the dominant regime are generally more eager to collaborate. This barrier was identified in 8 of the 25 case studies.

The “Indiv” barrier is found in particular the ‘changing from within’ setting (mainstream value chains), and, together with the lack of cooperation, limits the bargaining capacity of individual farmers against large-scale downstream operators. It was identified in 7 of the 25 case studies

### 1.5.4.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. rethinking advisory services towards cooperation**, and **b. developing a supportive policy framework** (Figure 37).



Figure 37: Key elements of solutions to the *Orga* and *Indiv* barriers.

The objective of rethinking the advisory services to foster cooperation (a) can be implemented through:

- › Establishing farmers’ networks where the coordinators endorse a role of facilitator of exchanges rather than a role of expert or advisor;
- › The promotion of farmers exchanges through webinars;
- › The promotion of good examples of cooperation and collective action;
- › Innovative advisory approaches based on farmers’ questions ( adaptative and responsive advisory).

The objective of developing a supporting policy framework (b) can be pursued through:

- › The development of incentives to support farmers to group: financial support for collective purchase, administrative simplification for groups and cooperatives, fiscal advantages for cooperatives;
- › The design of contracts which include collective payoff depending on the contribution to diversification.

### 1.5.5 Barrier « Unbalanced power in bargaining between farmers and traders »

#### 1.5.5.1 Barrier description (*Power*)

This barrier highlights the limited bargaining capacity of individual farmers against large-scale downstream operators.

This can be linked to the two previous barriers (i.e. lack of cooperation and individualistic mentalities among farmers). All of those barriers are encountered especially in the ‘changing from within’ setting, where farmers face big and highly specialized mainstream cooperatives or traders. As a consequence of this unbalanced situation, farmers may feel powerless, accept unfavourable rules and focus their scope of action at the farm level.

This barrier is seen only secondarily in the ‘building outside’ setting. Interactions between value-chain actors are generally less conflictual in alternative circuits, with fewer power imbalances, because most actors are small and share common alternative values.

It was identified in 7 of the 25 case studies.

#### 1.5.5.2 Key elements of solutions

The main solution identified across DiverIMPACTS case studies and experts’ knowledge is developing innovative value chains (Figure 38).



Figure 38: Key elements of solutions to the *Power* barrier.

The objective of developing innovative value chains (a) can be implemented through:

- › Building alternative value chains with less actors or actors who are willing to maintain fairness and transparency in the value chain;
- › The gathering of farmers in organization or cooperatives in order to increase their bargaining power;
- › The development of cooperatives gathering different actors of the chains (producer-processor-consumer cooperative) with a shared vision.

## 1.5.6 Barrier «Finding suitable contracts to address issues related to variability in production (flexibility, sharing risks and reducing control costs) » (Variab)

### 1.5.6.1 Barrier description

This barrier highlights the lack of suitable contracts between value-chain actors to share the risks associated with the variability of production, especially during the first years of experimentation of new practices. It is a transversal barrier encountered in all innovation settings. It was identified in 7 of the 25 case studies.

### 1.5.6.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: a. **securing and organizing the production**, and b. **securing suitable contracts** (Figure 39).



Figure 39: Key elements of solutions to the *Variab* barrier.

The objective of securing and organizing the production (a) can be implemented through:

- › Adapting production volumes according to variability risks and downstream actors' needs. For instance, produce into 2 years the needed volume for 3 years of transformation if there is a risk of bad quality every 3 years.

The objective of securing suitable contracts (b) can be pursued through:

- › Designing contracts with a certain flexibility of duration and pricing system allowing contracts' adaptations depending on the profitability of farmers;
- › Designing fair price contracts that integrate protection from various types of risks.
- › Designing pluriannual contracts covering at least 3 years and which include exit options for farmers.
- › Designing contracts that cover several crop species.

Options for innovative contract design are being further studied in the context of DiverIMPACTS' task 5.4, and will be published in D5.6.

## 1.5.7 Barrier « Lack of communication between value chain actors » (Comm)

### 1.5.7.1 Barrier description

This barrier highlights the limited cooperation between actors of the chains banning them to envision collective changes in the organization and governance of the value chains. Moreover, the farmers involved in diversification crops remain quite marginalized and scattered, which keeps them at distance from the existing institutionalized dialogues. A range of institutionalized space of dialogue exist nowadays, but they are largely occupied by traditional actors and conventional farming systems representatives. The difficulty for the “outsiders” is to obtain a place in those historical structures in order to make their preoccupations audible. This barrier is encountered both in the ‘building outside’ and ‘playing horizontal’ settings. It was identified in 6 of the 25 case studies.

### 1.5.7.2 Key elements of solutions

Two main types of solutions were identified across DiverIMPACTS case studies and experts' knowledge: **a. making the alternative farming systems more visible** and **b. developing a supportive policy framework** (Figure 40).



Figure 40: Key elements of solutions to the *Comm* barrier.

The objective of making the new systems more visible (a) can be implemented through:

- › Supporting, within existing structures, the development of branches for innovative farming systems;
- › A specific support to farmers 'organization which engage in alternative farming systems;
- › The mobilization of civil society actors on the topic of innovative farming systems.

The objective of developing a supportive policy framework (b) could be reached through:

- › The creation of new dialogue arenas including alternative actors;
- › The integration of those innovative farming systems representatives in official dialogues and policy consultation.

## 1.5.8 Barrier « No ensured quality of products to be bought, sold or to establish secured contracts » (*Qual*)

### 1.5.8.1 Barrier description

Similarly, to the other variability challenges (see barrier “Variab”), the quality of crop diversification products may hinder the development of new value chains and contracts.

### 1.5.8.2 Key elements of solutions

Key elements of solutions listed above are also relevant for addressing this barrier, such as:

- › Identifying the factors impacting crops' quality (see *Perf* barrier);
- › Setting insurance mechanisms to overcome variability of the quality (and the yield, see *Perf* barrier);
- › Designing pluriannual contracts allowing for progressive improvement of the quality (see *Variab* barrier);
- › etc.

## 1.5.9 Barrier « No ensured reciprocal benefits in farmers partnerships » (*Benef*)

### 1.5.9.1 Barrier description

The barrier refers to the absence of guarantee about the benefits crop diversification partnerships may bring. Benefits can be expressed in terms of yields, revenues, technical improvements, etc.

This barrier is reinforced by problems of communication between partners which may ban them to clearly formulate the expected advantages and possible compensation (see *Comm* barrier). Emphasis is therefore put on the possibility to draw up fair contracts guaranteeing that both livestock and arable farmers will derive benefits, especially in cases of grazing on winter cover crops and land exchanges.

This barrier is particularly present in the ‘playing horizontal’ ideal type. It was encountered in 4 of the 25 case studies.

### 1.5.9.2 Key elements of solutions

Two main types of solution were identified across DiverIMPACTS case studies and experts' knowledge: **a. developing a supportive policy framework**, and **b. rethinking advisory services** (Figure 41).

The objective of developing a supportive policy framework (a) could help:

- › Designing legal tools for framing those partnerships.

The objective of rethinking advisory services (b) could be done through:

- › Developing advisory skills for supporting such partnerships;
- › Developing tools for assessing and keeping track of the benefits for both parties;
- › Documenting examples of such partnerships and the related benefits.



Figure 41: Key elements of solutions for the *Benef* barrier.

## 2. Actors to be involved in the implementation of the solutions: an overview

For each solution identified, the actors to be involved in the implementation of the solution were identified (See Table 2 in appendix).

They include: Farmers (individually or as a group); Farming advisory services, agronomic R&D, agricultural education institutes; Public Administration & Policy; Socio-economic Research; Banking, insurance and risk management services; Downstream actors; Consumers and their representatives; and Civil society, environmental NGOs.

## 3. Conclusion and recommendations

While Morel *et al* (2020) identified 46 barriers to crop diversification, the collective expertise of DiverIMPACTS WP5 partners allowed identifying close to 200 solutions at the farm level and along value chains.

Barriers to crop diversification are interrelated (see DiverIMPACTS Policy Brief #2 (Antier C. et al. *in prep*)).

- Horizontally: e.g. at the farm level, the lack of access to innovative technical knowledge, the lack of resources and cultural/cognitive barriers may reinforce each other and impact the farmers' ability to undertake strategies of crop diversification.
- Vertically: e.g. in the value chains, the high variability of yields and quality of new crops at the farm level make investments for processing risky, and vice versa: the lack of reliable opportunities for processing crop production and marketing innovative products discourage farmers from investing in crop diversification. Another example is the lack of coordination between actors, that strengthen the difficulty of setting up new value chains and marketing opportunities.

As a consequence, enablers have to be rolled out with a systemic approach (DiverIMPACTS Policy Brief #1). Such a systemic approach will take into consideration all stages of the value chains as well as the interactions between them.

It must be underlined that some of the barriers and solutions are not only related to crop diversification but apply to the shift to agroecology in general.

Some solutions are suitable for more than one barrier. Methods can be used to find actions and/or solutions that can be considered as no regrets options: a farmer/actor should at least start with these solutions to combat his or her problem.

Solutions will be further tested and analysed by DiverIMPACTS' WP5 partners.

## 4. Partners involved in the work

*Collective expert assessment:* UCL, DLO (Wageningen University & Research), INRAE, Agrosolutions, Walagri and Baertschi.

*Methodology conception, workshop animation and report redaction:* UCL.

*Report review:* INRAE.

## 5. References

Antier C., Viguier L., Messéan A. and Baret P.V. (in prep). DiverIMPACTS Policy Brief #2: Recommendations for overcoming barriers to crop diversification towards a sustainable agriculture.

Morel K., Revoyron E., San Cristobal M., Baret P.V. (2020) Innovating within or outside dominant food systems? Different challenges for contrasting crop diversification strategies in Europe. PLoS ONE 15(3): e0229910. <https://doi.org/10.1371/journal.pone.0229910>

Paresys L., Stilmant D., Baret P., Bliss K., Canali S., Colombo L., Hellou G., Rossing W., Vandewalle A., Willer H., Messéan A. 2021. DiverIMPACTS Policy Brief #1: Systems approaches to promote crop diversification as a lever towards sustainable agri-food systems.

## 6. Appendix

**Table 2: Actors to be involved for implementing solutions to the barriers to crop diversification.**

Actors to be involved:

**Far:** Farmers (individually or as a group);

**Adv:** Farming advisory services;

**Adm & Pol:** Public Administration and Policy makers;

**Ag R&D:** agronomic R&D;

**SE Res:** Socio-economic research;

**Ban & Ins:** Banking, insurance and risk management services;

**Ups:** Upstream actors;

**Down:** Downstream actors;

**Edu:** agricultural education institutes;

**NGO cons:** Consumers representatives;

**NGO envi:** environmental NGOs, Civil society.

	Solutions	Far	Adv	Adm & Pol	Ag R&D	SE Res	Ban & Ins	Ups	Down	Edu	NGO cons	NGO envi
Lack of technical knowledge and references	Field experiments at the farm level	x	x		x							
	Field experiments by or with farmers' groups	x	x		x							
	Field experiments and research by/with downstream actors	x							x			
	Diversification of the farmers' sources of knowledge (networks, etc.)	x	x		x			x	x	x		x
	Access to knowledge from other regions or other countries	x	x		x					x		
	Knowledge through additional trainings	x								x		
Lack of economic	Assessing costs, investments and prices for the new value chains	x	x		x	x			x			
	Developing "peer-to-peer" farmers exchanges on prices and costs	x	x			x						

knowledge and reference	Transferring economic references from downstream actors to farmers and <i>vice versa</i>	x							x			
	Increasing the transparency of supply constraints and opportunities	x	x			x			x			
Need of investment for adapted machinery	Relying on second-hand machinery			x				x				
	Encouraging co-investments by farmers' groups			x				x	x			
	Supporting the adaptation of the existing equipment			x				x				
	Renting machines instead of buying them	x										
	Adapting capital expenses to area and volumes to be produced	x	x									
	Guaranteeing sufficient market outcomes								x		x	
Lack of technical knowledge and references about impacts on sustainability	Field experiments for assessing the impacts of new practices/crops	x	x		x	x						
	Monitoring by farmers of the impacts at the farm or plot level	x	x		x	x						
	Sharing of knowledge ad references by research/advisory institutions				x	x	x					
	Labelling that promotes products with high ecological value	x		x				x	x		x	x
	Training programs for farmers about sustainability indicators and practices	x	x								x	
Profitability is low, problematic or uncertain	<i>See solutions for the barrier Uncert_Perf</i>											
	Mitigating risks by increasing the number of crops on the farm	x	x			x						
	Internalizing some processing activities in order to increase the added value	x	x		x	x						
	Fair price mechanisms	x				x			x			
	Contracts that take into account the variability of the production and its profitability	x				x			x			
Uncertainties, risks and variability of agronomic performances	Field experiments at small scale first	x	x		x				x			
	Setting insurance mechanisms for addressing the risks of crop failure	x					x					
	Ensuring risk sharing with downstream actors or within farmers' groups	x						x	x			
	Fostering crop breeding for increasing the agronomic performances of new crops	x	x		x			x				
	Experiments led by cooperatives or advisory institutions	x	x		x							
Lack of technical knowledge about the impact on farming system and design	Identify successful crop combinations for diversification	x	x		x							
	Assessing the effects of crop diversification on farming systems	x	x		x							
	Assessing the impacts of minor crops in the context of diversification	x	x		x							
	"Peer-to-peer" farmer learning process	x	x									
	Transferring knowledge through training by farming advisory		x		x						x	
Lack of information because of problems with advisory context	Trainings for farmers to acquire knowledge		x	x	x				x	x		
	Peer-to-peer farmers or inter-actors exchange of knowledge and experiences	x	x	x	x				x			
	Development of a independant advisory services	x	x		x						x	
	Diversification of knowledge networks											x
	Promoting different sources of advice											
Current situation is still profitable on the short term	Identifying the agronomic and economic risks of conventional systems	x	x		x	x			x			
	Specific communication about the long-term risks of conventional systems		x	x	x	x	x	x	x	x		x
	Assessing and describing the advantages of innovative practices		x		x						x	x
	Communicating on examples and quantitative results.	x	x	x	x						x	x
Constraints in labour organisation (period, volume), mental or physical load	Reorganization of the labor force in order to manage the new activities associated with the diversification practices	x	x		x	x						
	Hiring service providers to manage some crop operations	x							x			
	Hiring an additional employee using the revenue from the new crop	x							x			
	Selecting crops with low work demand and/or crops that can help spread the workload along the year	x	x		x	x						
	Emphasize a cost-benefits approach to highlight the long term benefits of crop diversification	x	x		x	x						

	Support to farmers in reshaping their work routine and farming system		x		x	x				x		
<b>Barriers related to CAP, environmental or sanitary regulations</b>	Promoting the environmental benefits of diversification practices to overcome the fear of wasted time on extra regulations	x	x	x					x			
	Promoting the environmental benefits of diversification practices to overcome the fear of wasted time on extra regulations	x	x	x					x			
	Simplification of CAP paperworks in order to limit the supplementary administrative workload	x	x									
	K_Syst" barrier											
	Documentation about the regulations and how they apply to diversification crops		x							x		
	Advisory serices that focus on the clarification of regulations' application		x									
<b>Lack of adapted plant varieties in the local context</b>	Additional research on varieties and species relevant to crop diversification in the EU farming contexts	x	x		x			x	x			
	Providing seeds of relevant varieties and advice on the successful farming practices for these varieties	x	x		x			x	x			
<b>Need of innovation in machinery for field activities</b>	Adaptation of existing machines to new crops and new practices	x	x		x			x				
	Choosing the crops and practices in consistency with available machines and possible on-farm innovations	x	x		x			x				
	Identifying the innovations needed for crop diversification	x	x		x	x		x				
	Supporting farmers-to-farmers knowledge sharing about on-farm innovation	x	x									
	Communicating towards machinery providers		x	x	x			x				
	Supporting R&D and marketing of innovative machinery, suitable for crop diversification practices	x	x	x			x					
<b>Low agronomic performances (yield, quality)</b>	Identification of the factors impacting crops performance, in terms of yield and quality	x	x		x				x	x		
	Evaluation of crops' performance through multi-criteria assessment	x	x			x	x			x		
	Designing contracts with guaranteed prices to farmers					x			x		x	x
	Setting insurance mechanisms to overcome low/variable yields						x		x			
<b>Increased complexity for management and decision-making</b>	Developing management tools that take into account specificities of diversification	x	x		x	x			x	x		
	Setting advantages (e.g. higher added-value) that compensate for the increased complexity							x				
	"Advice" barrier											
<b>Cognitive frame and ways of thinking need to be changed &amp; Cultural barriers</b>	Reducing the misperception of the hazards associated with diversification practices		x			x						
	Integration of diversification practices in training & education programs	x	x		x	x				x		
	Development of specific advisory services	x	x			x				x		
<b>Seeds are hard or expensive to get</b>	Collective purchase of larger volume of seeds by farmers groups or cooperatives	x	x	x								
	Fostering exchanges of farmer-saved seeds within farmers networks.	x	x	x	x			x	x		x	x
	Assessing the seeds costs in comparison to the crop added value		x		x			x				
	Providing information on the existing seeds supply options								x			
	Supporting the development of quality seeds supply	x	x	x	x			x	x		x	x
<b>Farmers' lack of awareness about issues linked to specialisation</b>	Identifying the systemic nature of the problems in the farming systems	x	x	x	x	x	x	x	x	x	x	x
	Adopting multi-criteria evaluation to assess performance	x	x		x	x				x		x
	Promoting profitable crop diversification farming systems	x	x	x	x	x			x		x	x
	Fostering "peer-to-peer" farmers exchanges	x	x	x	x	x			x	x		
<b>Lack of available or adapted phytosanitary solutions</b>	Experimenting agronomic strategies for integrated pest management	x	x		x			x	x			
	Encouraging research on new bio-products to protect crops.				x			x	x		x	x
	Encouraging R&D for sustainable mechanical weeding				x			x	x		x	x
	Compensating lower yields with adapted sale prices and contracts						x		x			
	Grouping the minor crops in close geographic areas	x							x			

<b>Volumes are too limited in a given area to be profitably or easily collected</b>	Increasing the number of farmers and acreage dedicated to new crops	x	x	x								
	Supporting farmers' groups to manage the collection and storage activities	x	x						x			
	Rely on, or create, capacities for collecting small volumes	x							x			
	Setting up contracts that encourage farmers or farmers' groups to increase the crop acreage along years	x							x			
<b>Equipment for screening, cleaning, drying or storing requires investment</b>	Increasing the acreage/volume of the crop to be processed											
	Increasing the number of crops concerned by the new equipment	x	x		x			x		x		
	Selling processing services to other actors											
	Gathering farmers for collective investment or use	x						x	x		x	
	Financial support for the purchase of diversification-related equipment			x			x		x			
	Contracts for securing market opportunities			x				x	x			
	Identifying a valuable technical innovation	x	x		x			x	x			
<b>Equipment for processing requires investment</b>	Gathering farmers for collective investment or use	x						x	x		x	
	Sharing responsibilities and skills for the use of the new equipment	x	x					x	x		x	
	Investment in processing equipment may lead to obtaining contracts that would not be accessible otherwise. The equipment enables a diversification of the marketing opportunities.	x							x		x	
	Increasing the acreage/volume of the crop to be processed											
	Processing services could be sold to other actors if the equipment is not used at 100% of its capacity	x							x		x	
	Fair pricing mechanisms	x		x		x		x		x	x	x
<b>Competition on the global market with crops produced cheaper elsewhere (for processors or retailers)</b>	Developing specific, high added-value products	x							x			
	Communication on the specificities of the product: sustainability, etc.	x							x	x	x	x
	Securing markets through vertical integration or contracts	x							x		x	x
	Prospecting for niche markets with high added value	x				x			x		x	
	Managing the price ranges for ensuring a fair competitive context			x		x			x		x	x
	Promoting crop diversification in catering			x								x
<b>Equipment for screening (i.e. Separation of crops) requires investment</b>	Increasing the acreage/volume of the crop to be processed	x	x						x	x		
	Increase in the number of crops and volumes concerned by the new equipment	x	x		x			x				
	Selling services to other actors if the equipment is not used at 100% of its capacity	x							x			
	Organizing collective investments (farmers' groups)	x	x				x		x			
	Secure sufficient revenues with good pricing system					x	x		x		x	x
	Incentives or subsidies for funding new equipment for diversification	x		x		x			x		x	x
<b>Equipment for screening, drying, storing, cleaning, processing requires innovation</b>	Partnerships at the value chain level to co-adapt the processing	x	x		x				x			
	Partnerships of several processing stakeholders for innovation			x		x			x			
				x		x			x			
	Pricing system that ensures sufficient return on innovation											
<b>Regulations issues around sanitary, quality and purity aspects</b>	Communication about the high-quality standards of EU products		x	x						x	x	x
	Administrative support on regulatory aspects for actors undertaking diversification	x	x	x				x	x			
	Subsidies for regulatory and quality aspects in the context of crop diversification	x		x				x	x			
	Specific HACCP/certification procedures for crop diversification	x		x				x	x			
<b>Administrative or fiscal or accounting issues</b>	Increasing the flexibility of the CAP administrative tools so that innovative crop diversification practices can be reported and valued	x	x	x								
	Developing fiscal entities that facilitate transaction of crops or use of lands between farmers	x		x				x				
	Simplification of the administrative paperwork		x	x								

<b>Traders are reluctant to support solutions which may reduce inputs that they sell</b>	Creating alternative value chains for farmers to sell their crops	x						x	x			
	Development of multiple contracts with different stakeholders	x					x	x	x		x	x
	Making advisory and the provision of services/inputs separated		x	x				x				
	Increasing the tax to be applied on some inputs like some fertilizers and pesticides			x							x	x
	Offering subsidies for ecosystem services			x								x
<b>Dealing with diversification products brings higher costs</b>	Fair pricing mechanisms which spread the financial effort	x		x		x	x	x	x		x	x
	Collecting the production from a group of farms	x							x		x	
	Contracts guaranteeing a secure outlet	x		x					x		x	x
<b>Need to raise consumer's awareness or bad visibility of diversification benefits</b>	Labelling of products/farming systems that provide ecosystem services	x		x					x		x	x
	Increasing the price to differentiate the crop diversification products	x							x			
	Communication campaigns on diversification systems and products			x					x			x
	Communication on the environmental benefits of diversification			x					x			x
	Communication on health benefits of legume and new crops			x					x		x	x
<b>Uncertain or unstable market</b>	Adjusting the annual production volume to the demand	x	x						x			
	Managing stocks from one year to another to smooth the demand variability.	x	x						x			
	Contracts between value chain actors	x							x			
	Partnerships between processing and retail/marketing companies	x							x			
	Promoting diversification products for reaching environmental targets			x					x			x
<b>No pre-existing or very limited market</b>	Development of new products based on innovative crops	x							x			
	Increase the volumes produced	x	x						x			
	Communication campaigns on crop diversification and products			x					x		x	x
	Integrating new crops in existing processing chains					x			x			
	Assessing the demand					x			x			
	Growing the niche markets			x					x		x	
	Communication campaigns about the benefits of diversification for the environment and human health		x	x			x		x			
	Promotion of new products made with diversification crops								x			
	Distinctive labeling of the crop diversification products	x				x			x		x	
	Subsidizing crop diversification products			x		x						
<b>No ensured and/or fair sharing of added value between actors</b>	Development of a fair pricing label					x					x	
	New supply chains that integrate the development of innovative commercial practices							x				
	Contracts that offer transparency and fair distribution of the added value	x		x		x			x		x	
	Vertically integrated value chains with specific objectives of fair price and sharing risks	x							x		x	
<b>No ensured or limited volumes to buy/sell products or establish secure contracts</b>	Calling on an intermediary actor to collect sufficient volumes								x			
	Progressive increase of diversification crops volume in a given area	x	x						x			
	Grouping of farmers who implement diversification practices	x										
	Farmers cooperation and knowledge/skills exchange	x	x					x				
	Setting contracts with a certain flexibility on the quantity and quality	x							x			
<b>Duration of contracts not enough to secure farmers in taking risks and investing</b>	Downstream actors providing funding/services to the farmers to help them addressing the necessary investments	x					x		x			
	Purchasing collectively the equipment in order to share the risks	x							x		x	
	Designing pluriannual contracts	x							x		x	
	Designing plurispecies contracts	x							x		x	
<b>Limited or no cooperation between</b>	Establishing farmers networks for knowledge sharing	x	x									
	Promotion of peer to peer exchanges and learning through webinars	x	x							x		

<b>innovative farmers &amp; Individualistic mentality and lack of trust between farmers limit collective action (2 barriers merged)</b>	Promotion of good examples of cooperation and collective actions		x	x										
	Developing responsive advisory services based on farmers' questions		x											
	Developing administrative, financial and fiscal incentives to support the grouping of famers			x										
	Contracts with payoff depending on the contribution to diversification	x					x				x			
<b>Unbalanced power in bargaining between farmers and traders</b>	Building alternative value chains with specific actors	x	x								x			
	Gathering of farmers to increase their bargaining power	x		x										
	Developing cooperative organisations that gather different actors of the chains	x									x			
<b>Finding suitable contracts to address issues related to variability in production (flexibility, sharing risks and reducing control costs)</b>	Adapting production volumes according to variability risks and downstream actors' needs	x									x		x	
	Designing contracts with flexibility on the duration and the pricing system	x						x			x		x	
	Designing fair price contracts that integrate protection for various types of risks	x						x			x		x	
	Designing pluriannual contracts	x						x			x		x	
	Designing plurispecies contracts	x									x		x	
<b>Lack of communication between value chain actors</b>	Developing within existing structures, a branch dedicated to crop diversification practices and products	x	x	x							x			
	Supporting farmers' organizations engaged in crop diversification	x	x	x				x						
	Mobilizing civil society actors on crop diversification matters												x	x
	Creating new dialogue arenas including alternative actors			x										
	Integration of alternative farming systems representatives in institutionalized dialogues		x	x										
<b>No ensured quality of products to be bought, sold or to establish secure contracts</b>	See Perf + Variab													
<b>No ensured reciprocal benefits in partnership (especially for land arrangements)</b>	Designing legal tools to frame innovative partnerships			x										
	Developing advisory skills for supporting innovative partnerships		x					x						
	Developing tools for assessing the benefits of such partnerships		x					x	x					
	Documenting examples of such partnerships							x	x					