Legume Translated Report 5

Production constraints and opportunities: A Delphi study within the Legume Translated consortium

Donal Murphy-Bokern (DMB)
Montse Costa Font (SRUC)

June 2022

Legumes Translated

Legumes Translated (Translating knowledge for legume-based farming for feed and food systems) is an international research and development project funded by the European Union through the Horizon 2020 Programme under grant agreement number 817634. The Legumes Translated research consortium comprises 17 partners in 9 countries.

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About this report

This report sets out the findings provided under the Legume Translated contract deliverable 3.2 (Production constraints and opportunities).

Citation

Please cite this report as follows:

Murphy-Bokern, D. and Font, M. C., 2022. A Delphi study of production constraints and opportunities for legumes grown in Europe. Legumes Translated Report 5. Available from www.legumehub.eu

Legumes Translated (Translating knowledge for legume-based farming for feed and food systems) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817634

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Introduction

What do experts really think? Most of us have the experience of meeting people who have a deep practical understanding of a theme that is not revealed in scientific and research reporting. This tacit knowledge remains unrecorded and only available through informal interactions. The purpose of the work reported here was to obtain insight into the views and idea of a large number of experienced individuals who participated in the Legumes Translated project. The work used the Delphi technique to access the insights into opportunities and constraints of the consortium's experts in a structured way.

The overall purpose of Legumes Translated is to compile and synthesise knowledge from research and practice-based experts and prepare it for use in practice. The introduction and expansion of legume crop production and use in Europe represents a fundamental change on farms and in other value chain businesses. Ultimately, increasing the use of European-grown legume crops in our farming and food systems is about how the agri-food system uses and impacts on the nitrogen cycle. It is a fundamental change with impacts at the global, European, national and local levels. In advancing knowledge-based change, the question of opportunities and constraints arises. After consideration of the opportunities in the consortium, we opted to use the Delphi method to systematically access the knowledge and insights of experts in the consortium. All consortium expert participants were invited to join the Delphi panel which started its work in August 2020.

Methodology

The Delphi method is an analytical method to identify consensus about the topic. It does this through analysis and convergence of opinions from respondents, usually experts commenting within their domain of expertise. It is an iterative process that collects and refines the views of a group and establishes an understanding of their positions. The method involves the repeated individual questioning of the experts through a series of rounds. In each round, every participant takes part in an interview, usually through a semi-structured questionnaire. The first round is exploratory. Each subsequent round/questionnaire is developed on the basis of the results of the previous round. For each round, the researcher collects, edits, sums up comments and reasons underlying opinions and views, and returns a statement of the position of the whole panel and the participant's own positions to each participant. The Delphi method has three key features:

- Anonymity: respondents are anonymous to each other but not to the researcher. This reduces the effect of dominant individuals and minimizes the effect of group dynamics such as manipulation or social pressure to conform to others in the group.
- Iteration: participants are allowed to refine their views in light of the progress of the group's work from round to round.
- Controlled feedback: participants are informed of the other participants' opinions, perspectives and judgements and provided with the opportunity to clarify or change their views.

The potential strength of using the Delphi method here is its ability to systematically scan the understanding and insights of a large number of consortium participants who are experts in different aspects of legume production and use. It is especially useful where objective quantified information is not available or where qualiative information and expert opinion is potentially valuable, which is particularly the case here. It was developed in the 1950s to systematically access the views of experts in making specific predictions.

We conducted the process in four main phases:

Round 1 invited all expert members to address an open question about opportunities.
Round 2 asked each expert to score propositions derived from Round 1.
Round 3 asked each expert to answer a series of 19 open questions about constraints.
Round 4 asked each expert to score propositions derived from Round 3.

Round 1 – Open questions about opportunities

The first phase looked at opportunities and the second looked at constraints. The process started with an open invitation to all project participants on July 29 2020 to join the panel through responding to a question with two supplementary questions. The opening question was: *In your expert opinion, what opportunities do you see for legume-related development that impacts on farmers?*

Twenty-five project participants responded thereby forming the panel (one more expert joined later and participated in some rounds). The responses were from the following partner organisations: SRUC (UK), HEL (Finland), DMB (Germany), LTZ (Germany), FiBL (FiBL), Teagasc (Ireland), ZALF (Germany), Nireus (Greece), THES (Greece), ABI (Bulgaria), BESH (Germany) (LLH (Germany), Donau Soja (Austria), AST (Ireland), and IFVC (Serbia) The replies were compiled into a report (Annex 1) and presented to all panel members on 6 October. This documents the responses without revealing the names of the respondents. This was followed by a synthesis report on 9 December (Annex 2). This summarises the responses in relation to the following stages of the value chain which provided a framework for the remainder of the study:

POLICY
Farm policy
Environmental policy
Market policy

PRIMARY PRODUCTION – FARMERS
Conversion to organic farming
Agricultural systems change
Farming systems change
Cropping systems change

PROCESSING AND MANUFACTURING
Opportunities from improved quality asessment
Opportunities from brand protection and corporate social responsibility (CSR)

Opportunities from processing technology

CONSUMERS
Opportunities from consumption change
Opportunities from the demand for local food

Round 2: Scoring of propositions about opportunities

This synthesis was followed by the generation of propositions that each panel member was asked to score according to the extent they agreed with each one. A six point scoring scheme was used ranging from No agreement to Very high agreement. These 41 propositions were grouped in relation to the value chain opportunities synthesised from Round 1. 25 of the 26 panel members scored the propositions. The scores were tabulated to identify mean and standard deviation values for the scores for each of the proposition. A significant number of the propositions were characterised by a high variability in scores and so the panel were given the opportunity to re-score taking into account the mean score and standard deviation for the first scores.

Round 3: Open questions about constraints

Round 3 focused on constrants was initiated on 25 January 2021. Round 3 asked panel members to answer 19 open questions related to constraints relevant to the opportunities identified in Round 1 and Round 2. 22 of the 26 panel members responded to this. The synthesised results were circulated to panel members on 5 March 2021 (see Annex 5).

Round 4: Scoring propositions about constraints

The analysis of responses to the open question on constraints was used to generate a series of 53 propositions about constraints put to panel members on 9 March.

Results

The individual experts' responses to the open question about opportunities are set out in Annex 1. The synthesis of these is provided in Annex 2. Annex 3 presents the scoring of the propositions (Round 2) on opportunities derived from Round 1 responses. The results of the assessment of constraints are presented in Annex 4 (responses to open questions), Annex 5 (synthesesis of responses) and Annex 6 (scoring of propositions). The results in Annex 3 and Annex 6 show the number of score responses to each proposition, mean level of agreement with propositions, and the standard deviation around the mean. A standard deviation of less than 1.00 indicates a high level of consensus.

The responses reflects the breadth of experience and competence of the 25 respondents. Even though the work of a large proportion of the experts concentrates on crop production, it is clear that they see opportunities across the value chain from policy development to consumption. The overall picture is of diverse market-led opportunities

that will be enhanced if they are supported by policy intervention at farm level. Generally speaking, farm technology-led opportunities play a secondary and support role. It is clear that reducing reliance on imported soy is on commercial minds.

The information presented in the annexes is summarised here. This combines a synthesis of the two sets of responses to the open questions with the scores for the two sets of propositions. The 0-5 score for a proposition is indicated in brackets. The score ranges from 0 for no agreement to 5 for very high agreement. All scores above 3.00 indicate good agreement with the preposition among experts.

Public policy making

Policy is the process of turning political goals into action in the real world. Policy making is an important part of the value chain and policy communities who contribute to this includes all the relevant stakeholders who contribute to policy formation: professional policy makers, politicians, representative of key stakeholder groups such as farm unions and associations, and non-governmental organisations.

Farm policy

There is strong consensus that public policy interventions are an opportunity. Panel members indicate that voluntary coupled supports are a cost effective incentive for increasing legume production (Score: 3.73). These payments are used by 16 member states and so this high score and associated consensus might reflect familiarity with them. However, experts identify a wide range of constraints to farm policy impact within the agricultural policy community itself. Policy makers' concerns (e.g., about cost or market distortion) constrain the implementation of voluntary coupled support schemes for legumes (Score 3.00). The 'decoupling' process can be traced back to reforms that were started nearly 30 years ago and there is an instinctive resistance to reintroducing or retaining coupled payments. Coupled supports are also constrained by funding mechanisms that limit their impact. The dependence of these measures on national policy positions make them unstable in the eyes of long-term investors in value chains, for example, plant breeders. In addition to the fundamental resistance to market-distorting measures, experts report that some national farm policy communities do not see arable farming as a priority for public intervention. Arable crop production is less system-relevant than livestock production which has a large post-farm processing infrastructure in meat and milk processing.

Several experts refer to the potentially greater impact and acceptance of payments that are focused on diversified cropping systems (rather than single crops). The use of this approach is less widespread in the EU and so the agreement that these whole-farm' payments for radical diversification of cropping are a cost-effective incentive for legume crop production is low (Score 2.57). Those experts who are positive about whole-farm diversification payments indicate that they are more closely linked to an agri-environmental outcomes (more diverse cropping that includes legumes) than payments for specific production lines. These farm-level payments therefore more closely follow the principle of 'public money for public goods'.

Farm payments remain important especially because experts do not think interventions are constained by political resistance to these interventions in society (Score 1.16). In other words, they think that public acceptance of farm payments for legumes is relatively high.

Farm organisations are seen as supportive of voluntary coupled payments but there is some resistance perceived to whole-farm payments for crop diversification (Score: 2.56). The switch from direct area-based farm payment to payment linked to environmental measures and practices is accepted reluctantly.

Environmental policy

Integrated policy development involves the development of interventions that have multiple impacts in several areas of policy. It is difficult in practice. The Green Deal Farm to Fork Strategy is a breakthrough in moving towards the integration of agricultural, environmental (esp. climate), food, and health policy in the EU. While this does not support legume production specifically, it could have far-reaching indirect effects that create a more supportive environment. These include an emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about dietary change that will create a supportive market for plant-based food markets.

Some policy instruments such as farm-gate nutrient balancing have the potential to support several policy outcomes simultaneously. There is moderate agreement and consensus with the propositions that nutrient or biodiversity policies could incentivise legume production and use (Scores 3.35 and 3.14 respectively). However, there is strong consensus that a lack of an integrated (systems) approach to agri-environmental policy constrains the development of legumes (Score 4.00). For some experts, the impact of this is reinforced by the lack of evidence of benefits for biodiversity at the individual crop level (Score 2.72).

There is some expectation that agricultural policy in the United Kingdom will become more integrated after Brexit resulting in more favourable conditions for legumes. Although not seen as a serious constraint by many, some experts report that there is a general tendency in the farm organisations to reject regulation and claim that there is no economic alternative to the farming or cropping systems that are currently dominant. The recent negative reaction of farmer groups to proposals to limit nitrogen fertiliser use on grassland is a good example. Incumbent interests instinctively lobby against change because all change risks generating losers as well as winners. Maintaining the status quo for the interests of the pre- and post-farm sector is also a big driver of this conservatism.

Market policy

There is very high consensus that policies that would intervene directly in markets for feed ingredients mandating minimum levels of inclusion of European-grown grain legumes would have a large impact (Score 4.32). However, this is constrained because direct public policy intervention in markets in this way is practically impossible due to WTO rules. Consequently, public policy makers' reluctance to impact on commodity markets constrains legume development (Score 3.68). Policy makers lack a framework for strong intervention in markets.

With regard to softer interventions, relatively few experts agree that public funds could be used to effectively to support public awareness of supply chains and products that use

European-grown legumes. Options are advertising campaigns, certification of origin and labels (Score 2.74). Development is constrained by a lack of ambition to use soft market instruments such as origin labelling (Score 3.50). However some experts with experience of the feed sector highlighted that ingredient origin labelling on feed at national level could stimulate industry interest in local sustainable protein sourcing.

Commercial actors recognise that the economic case for boosting European protein production is weak as long as we have competitively-priced protein from South America in commodity soya. Consequently, the commitment of farmers and processors to commodity trading constrains the development of new value chains (Score 3.45). The exploitation of comparative advantage dominates thinking. Reputational risks from this remain low because of consumers' lack of knowledge of how protein is sourced (Score 3.50). Commodity trading dominates the sourcing of feed ingredients in the main livestock sectors. Even sectors that foster a green image such as for dairy products are committed to purchasing these inputs at the lowest cost. One expert reported that those in the trade and livestock production "know the price of everything but the value of nothing". Experts report that the agribusiness community is not only dedicated to commodity trading in plant protein, it also discourages system change that might result in reduced markets for farm inputs e.g., fertilisers and feed. Increasing legume use reduces these markets and might even support on-farm feed production.

Primary production – farmers

The results relating to farming are presented in a system hierarchy starting with agricultural systems (the level of interaction between farms and other businesses), within farms, and at the level of the individual crop.

Agricultural systems

There is high consensus that growing societal interest in sustainable protein sourcing supports changes in agricultural systems towards using legumes (Score 3.96). This sustainable sourcing is characterised in particular by efforts to disconnect value chains from land-use change in South America. However, 'deforestation-free' alone will not be a strong driver. The impact of 'deforestation-free' products on legume production is constrained by the wide range of other competitive 'deforestation-free' protein sources (Score 2.81). These include soy from North America, sunflower meal, rapeseed meal, and a range of crop co-products. Not only are these 'deforestation-free', they are readily available as traded commodities. There is strong agreement that the development of legume production in agricultural systems is constrained by consumers' lack of awareness of the sourcing of protein (Score 3.84). There is a lack of labels that summarise agricultural and farming systems in the same way organic labelling does (Score 3.20).

The continued commitment to commodity trading is seen as a constraint by most experts. Therefore, the need to build value chains based on European legumes using positive messages about European farming was emphasised. Pointing the finger at over-seas production systems is not always helpful. The case for change in Europe should be built on a drive to improve European cropping practices, especially through better rotations, not by excluding imports.

Food sectors vary in how consumer sensitivities are perceived. There is increasing interest in substituting imported protein in the dairy sector in particular. For example, the major protein source in the Irish dairy sector is the protein in grass. The quality characteristics of soya are not as relevant to ruminants as they are to monogastrics, so replacing soya in the dairy sector is relatively easy. Soya is easily replaced by faba bean and pea especially for moderate yielding dairy cows. A shift at a national agricultural system level towards more sustainable protein sourcing is seen as a possibility.

Experts highlight opportunities in aquaculture in particular. Seafood is an important part of healthy diets and markets for farmed fish are particularly sensitive to consumer expectations for traceability and environmental performance. The challenge is to maximise the plant-based proportion of fish diets to minimise the dependence on fishmeal and fish oils. The performance of legumes is promising so far and they could support further growth of fish production. The opportunity is rooted in the expectation that European aquaculture will move from sourcing feed ingredients using international commodity trading to more regional sources based on verified sustainable production practices. This is already supported by the sector's commitment to non-GM sourcing. The commitment to food production with a reduced environmental footprint and the actual need of the fish feed manufacturers to exercise reliable quality control in the raw materials have created the circumstances for a change in the aquaculture supply chain. It is argued that such a change will be appreciated by informed premium consumers.

The dominance of commodity trading with the associated focus on price at all stages of the supply chains is a major constraint. There is commodity trading both for inputs (feed) and outputs (carcase meat, milk and eggs). Even industry players who are well-placed to benefit from a market for 'deforestation-free' products or other claims are reluctant to raise awareness about how animals are fed. Furthermore, market efforts to improve production practices are focused on animal welfare: considering where feed comes from is down the list of priorities. In addition to finding the lowest price, commodity trading gives access to large volumes of uniform specified raw material of consistent quality. The development of legumes that compete with commodity protein supplies needs large volumes. Most experts agree that the reluctance of farmers to cooperate between themselves and with other supply chain partners to assemble this volume constrains development (Score 3.55).

Despite the dominance of commodity trading, the experts see diverse avenues to change including the use of producer contracts and small-scale processing technologies to support local supply chains. Producer contracts can replace open commodity trading leading to increased legume production (Score 3.67). Contracts allow a price to be fixed that the contract parties agree is fair and allows production to be sustained into the future. Producer contracts instead of open market trading are particularly relevant for food products and for high value niche livestock products. Experts did not confirm that there is some producer or processor resistance to fixed price contracts due to their binding effect on contract parties (Score 2.00) or due to bureaucracy (Score 2.38).

Better linking of livestock production to the crop resource base (land) has a positive impact on the development of livestock production. At the European level, this involves moving production from the areas of concentrated livestock production in western Europe to eastern Europe where a much larger arable land resource is available, especially for

the efficient local recycling of nutrients. This also addresses social problems arising from the exploitation of migrant labour in west European meat processing. This change could impact on legume production in two ways: by reducing pressures on land use in the west (especially for disposal of animal slurry) and by creating new markets for protein-rich feed ingredients in the east. However, experts agree that the transfer of 'standard' meat production to the east will reinforce commodity trading focused on imported genetically modified soya and therefore not stimulate European legume production and use (Score 3.67). Consequently, few experts agree that moving Europe's pig and poultry production to eastern Europe could support increased legume production in Europe (Score 1.61).

The development of small-scale processing technology is seen as an important part of moving towards more diverse agricultural systems that better use local resources (Score 3.52). For example, small scale soya processing equipment enables pioneering farms to create a regional value chain using their own soybeans. The equipment needs to be carefully calibrated to guarantee the quality. Impact on legume development is constrained by a higher cost compared with industrial processing (Score 3.05).

Technical opportunities linked to reducing costs or moving to lower cost farming are also highlighted. Moving to a lower cost base includes increasing the use of forage legumes on dairy farms. While this may reduce farm output and turnover, the greater reliance on local resources reduces costs and stabilises the farm economy by reducing exposure to volatile input prices. This leads to more rewarding farming activities and possible higher returns from corporate social responsibly schemes.

The growth of organic production can drive legume production and use more widely in agri-food systems (Score 3.65). It plays a role where high premia can stimulate the uptake of 'new' legume crops such as soybean in a region. But most experts agree that the impact of organic farming on conventional farming is limited by a lack of relevance of organic practices to conventional (Score 3.18). The organic sector is still a slow-growing niche in many countries. Its impact in eastern Europe is limited. Organic farm businesses are focused on that niche and don't impact outside it. Lessons learnt from organic producers are not translated to promote both the yields and the environmental benefits. However, some experts draw attention to a history of transfer of practices from organic to conventional agriculture. Some practices that in the past were considered the preserve of organic are now available to conventional farmers who may be particularly interested in soil carbon sequestration or in improving biodiversity.

Farming systems

By farming system, we mean the organisation of individual farms and their enterprises.

Farms are locked into high-input/high output systems. There is strong agreement that these simple intensive linear farming systems constrain the development of legumes (Score 3.89). However, the experts only moderately agree that moving towards lower cost farming systems is a strong, long-term and real driver behind increased legume production (Score 3.36). Similarly, they only moderately agree that increasing grain legume production is an economically viable option for mixed farming systems (Score 3.09). They do not agree that there is a strong trend towards mixed farming systems which offer opportunities for increasing legume production (Score 1.75). The demand for land on farms with intensive grass-based dairy enterprises was highlighted as a

constraint to including legumes in mixed farming systems. Grass-based dairy production competes with other land uses, especially since the lifting of milk quotas.

Traditional research conducted over typical 3–4 year timeframes does not provide the long-term systems assessments that are needed to look at the full economic picture of system change. Consequently, under-valuation of the long-term economic performance and resilience of more complex/diverse and less-intensive systems constrains legume production (Score 4.05). Lower cost systems may be as profitable as high cost systems but risks are perceived to be greater. Farmers are focused on the traditional annual gross margin calculations which are easier than more holistic assessments that integrate multi-annual effects and that also consider effects on overheads and fixed costs, for example the effect on costs of a more even distribution of workload at sowing and harvest.

Moving to less intensive systems with greater reliance on on-farm feed etc. generally involves reduced direct input costs but increased complexity. Within this, greater reliance on farm-produced protein may also be rewarded by certification schemes and protect valuable brands. Managing complexity involves increases in other types of costs, especially management time. Convenience and simplicity are major attributes of the services offered by feed compounders and their practical value to farmers should not be underestimated. A compound feed can be a truly complete feed (for monogastrics) or a complete complement for forages (for ruminants). Introducing a protein-rich home-grown feedstuff such as faba beans means the farmer has to make other changes to livestock diets, requiring time and probably introducing further complexity. The avoidance of complexity is a major constraint in moving towards lower cost systems that use legumes. Consequently, few experts agree that there is a strong trend towards mixed farming systems which offer opportunities for increasing legume production (Score 1.75) or that cereal-legume intercrops/bi-crops are a viable way of introducing legumes for on-farm use on mixed farms (Score 2.64). Yield instability in grain legumes is a constraint to reliance on on-farm or local crops. On the other hand, the yield stability of forage legumes in droughts (e.g., lucerne) favours uptake.

Cropping systems

Experts drew attention to a wide range of technical opportunities at the cropping system level. There is high agreement that legumes compete with, or could compete with, other crop options on farms (Score 3.83). In summary, there is potential for the performance of grain legumes to be improved using technical innovation. Grain legumes are relatively easily adopted by farmers using common farm machinery (Score 3.00). Knowledge of effective techniques spreads easily within the farming community. Relatively few experts agree that the performance of legumes is constrained by farmers' lack of access to technologies (Score 2.75) or knowledge (Score 2.80). Experts' scoring of the three major agronomic constraints is relatively low for weeds (Score 2.89), diseases (Score 2.67) and pests (Score 2.56). In summary, developing legumes is not particularly affected by agronomic or technical constraints at the farm level.

The selection of well-adapted cultivars optimising G x E x M (gene x environment x management) is regarded as the foundation of efficient cropping. Substantial gaps between potential and actual yields remain, due in part to legume crops not being given priority in farm operations, especially where several crops compete for attention at sowing.

The underlying challenge is to increase the competitiveness of legumes compared to other crop options. Experts agree that other crops have reached barriers within crop systems due for example to grassweeds in winter cereals. Yield depressions in oilseed rape and in sunflower are causing farmers to look to other crop options which reduce these crop rotation problems. Declining performance of cereal and oilseed crops provides an opportunity for legumes on farms (Score 3.59).

There is a lack of understanding of the real farm-level economic performance of crops. The real costs of high-input cropping systems are not fully appreciated. In addition, legumes addressing a wide range of problems associated with simplified cropping systems, several experts mention that some legumes are competitive in cropping systems on the basis of their crop output alone. Soybean is competitive in parts of south-east Europe. Faba bean yields are particularly high in Ireland but this advantage is offset by the fact that the yield of other crops is also high in Ireland.

Plant breeding can significantly improve the on-farm competitiveness of grain legumes compared with other crops (3.87), both for food (Score 4.00) and feed (Score 3.91). However, the development of legumes is constrained by the fragmented breeding effort which reduces breeding progress (Score 3.37). Unlike maize and sunflower, there is no hybrid breeding and so the incentive for private investment in plant breeding is relatively weak. The breeding challenge is complex with the need to improve several trait complexes together: adaptation to environments to increase yield and yield stability, improvements in quality, and disease resistance. Gene editing will help. Plant breeding is a long process (over several years) and so the breeders need to be sure of the traits that are important to sell the seed after that period are valid. Breeding needs to give more attention to traits that will allow production in a wider geographical range, especially cold tolerance and winter hardiness (for cool-season legumes). More attention needs to be given to quality traits. These can be a game-change in local markets.

The market for seed is small and the flow of royalty income is not secure. If there were more breeding efforts, yields could increase and stabilise. Since improved germplasm of inbred crops is a public good (available to all and non-rival in consumption), public funding for breeding is justified to address the resulting market failure. This could be done through public research organisations. It would be better to provide support for innovation in the breeding programmes directly. Soy breeding has the advantage of access to the global soy effort. However, even this does not match the effort invested in maize and other cereals.

Although there are examples of good cooperation between academic-based and commercial breeders, pre-competitive pre-breeding is not strongly organised across Europe. This means that the connections between public academic research in relevant genetics and the genetic improvement of the crop could be stronger. Publicly-funded research is dominated by academic interests. Academic outputs are still the driver behind much of the public research activity.

Some public plant breeding activities in eastern Europe are still influenced by the idea that region-specific breeding programmes are needed. It is argued that parent maintenance and selection, the crossing, the establishment of lines and finally the

selection of lines as new cultivars must take place in the environment in which the cultivars will be grown. A more systematic international approach that separates crossing from selection for different environments is more efficient. This means relatively centralised generation of variability (crossing) combined with local selection from breeders' advanced lines. Feedback from local selection to the centralised parent selection and cross is needed to improve the match to environments. The lack of good functioning local selection by an active seed trade is a constraint in some countries.

Intermediate processors can fill a niche by providing the heat treatment necessary to denature lipoxygenase in beans to be used for wet processes. This opens up opportunities for small companies specializing in heat treatment who can supply other food-processing companies with certified raw materials. Those processors in turn could focus on favourable sensory attributes when developing legume derived food products.

Experts also highlighted crop species in themselves as opportunities. These include lucerne and red clover as forage species that fit into arable rotations. Whole crops of faba bean, pea and cereals are also mentioned. There are also references to the introduction of faba bean into rotations in marginal arable regions (Scotland).

The inoculation of seed is regarded as a very important technology, including for pea and faba bean. The performance of pea and faba bean can be increased using seed inoculation (Score 3.05).

One expert saw an opportunity to improve grain legumes by applying application of the principles of crop physiology to the agronomy of legume breeding and cropping. We know that the increases in the grain yield of cereals in the last fifty years is due to the increased capture of resources by crops, especially solar radiation and water, from a longer growing season. Crop physiological principles (e.g., early canopy growth, canopy architecture, light interception, phenology etc.) as used for cereal crops will benefit legume crop development (Score 3.57). Compared with the standard autumn-sown cereal and oilseed crops, spring-sown grain legumes are disadvantaged by the shorter growing season and associated susceptibility to drought (Score 3.45). Extending the growing season as was done with the switch to winter cereals is an obvious option that comes from crop physiological principles. This is relevant for the cool-season grain legumes, especially in west and south Europe. Reliance on spring-sowing is a constraint. From a crop-physiological viewpoint, the spring-sown cropping characteristic is a constraint, for both yield and yield stability, in the competition with other cropping options on the farm. The performance of pea and faba bean can be increased using autumn sowing (Score 3.24). Winter wheat, barley and oilseed rape are extraordinarily well-adapted to most European agri-environments. The advanced development and competitiveness of other spring-sown crops such as sunflower, maize and spring barley constrains the development of legumes (Score 3.11). Legume development is constrained by a lack of appreciation and understanding of the wider benefits of spring-sown break crops in the rotation (Score 3.60).

Even where spring sown arable cropping is common (spring barley in Ireland, sunflower in south-eastern Europe), there are very good reasons for farmers to continue using those other spring-sown crops instead of spring-sown grain legumes. In particular, hybrid sunflower is well-adapted to south-eastern Europe. Part of this is due to the much greater investment in plant breeding linked to the hybrid character which gives breeders

a good return on their investments. The same applies to maize over a larger part of Europe.

Processing and manufacturing

Quality assessment

The development of legumes is constrained by the poor connection between high-value end users and growers (Score 3.32). Experts therefore strongly agree that more precise legume grain quality assessments enables farmers to benefit from high-value markets (Score 4.00) and supports the competitiveness of local and regional legume production (Score 3.96). The standard assessment of grain quality does not recognise important quality differences, especially for food and higher-grade feed uses. There is no food-grade valuation (as provided by Pulse Canada and Pulse Australia) and the feed valuation is based mostly on the value of the protein fraction with reference to commodity-traded soya. Trading based on food-related quality parameters would enable farmers to be rewarded for food-grade quality. The same approach can also stimulate and reward production for high-value feed markets, for example in aquaculture. This would enable farmers to aim for the high-value markets by producing top-grade clean legumes. However, experts agree that even if there was improved quality and more precise quality control, the market would still favour standardised soya and other internationally traded commodities (Score 3.26). These end users are specialised in their markets and are accustomed to getting the raw material they need from standardised soya products. A drive towards more precise quality management leads also to smaller markets and quantities and a move away from commodity trading. Consequently, these opportunities are overshadowed by the dominance of commodity trading which does not reward growers who produce high quality for specific uses. This constrains the development of legumes (Score 3.50).

In addition, precision quality management requires investment in quality assessment equipment. Experts moderately agree that lack of access to the technology needed for precise quality control constrains the development of legumes (Score 3.19). For food, the problem is that special properties for use as food (taste, mouth-feel/structure of the food product) are difficult to measure by chemical/physical analysis. The crop needs to be tested in food production with a decision made at the level of the cultivar. For high-quality production therefore contracting farmers to grow the chosen cultivar is the solution. It might be advantageous to select specific cultivars also for feed uses.

The development of legumes is constrained by poor understanding of quality for specific uses (Score 3.37). For example, there is a lot of information in the literature on antinutritional components but few people have an overview of how different anti-nutritional substances determine final product quality, in particular considering the different options for reducing their effects. This lack of precision also applies to the quality properties of starches and proteins in legumes. Links with the user industries helps bridge this gap. Also, more enviromental credits will encourage the feed industry to seek out more sustainable feed options. Labelling will encourage this. For feed, the intense competition from by-products of other oilseeds discourages efforts to improve specially feed qualities. Quality characteristics such as low presence of anti-nutritional factors are not rewarded.

Brand protection and corporate social responsibility
This area is about efforts firms make to meet the social and environmental performance expectations of consumers. These range from avoiding scandals through to product differentiation related to environmental and social performance claims. Life-cycle assessment is an important tool for CSR, used in particular for carbon-foot printing.

Brand enhancement/protection is a major driver behind increased market demand and prices for locally-grown or regionally-sourced legumes (Score 3.70). There is increasing realisation of the need to protect brands, particularly in countries where agriculture depends on exporting food products. The demand for one effort cascades to others, for example the demand for 'non-GM' leads to demands for more local sourcing generally. The current reliance of European livestock on imported protein threatens the 'green' image in high-value export markets for products such as beef, milk products including butter and baby formula. For example, an estimated 900,000 tonnes of protein (equivalent) in concentrated feed are fed to Irish livestock each year. There is also agreement that consumer markets will move towards requiring greater protein self-sufficiency (less reliance on imports) and this will increase farm prices for legume crops (score 3.50). However, experts agree strongly that a lack of consumer understanding of the role of protein sourcing in the environmental impact of food constrains legume development (Score 3.85) and that consumers are not willing to pay for higher social and environmental production standards (Score 3.74). There is now a willingness amongst industry participants, especially a number of larger dairy co-ops, to find alternatives to protein imported from outside Europe. This needs a whole industry approach at the national level with the whole industry moving forward together. The difficulty of quantifying the better environmental performance of European-sourced legumes on labels (e.g., using 'carbon foot printing') constrains legume development (Score 3.37) and experts generally do not expect that demands for reduced carbon footprints will lead to increased farm prices for legume crops. Experts strongly agree that the continued dominance of commodity trading constrains the contribution of European-grown legumes to sustainable supply chains.

Brand protection also extends to organic certification. More stringent organic certification requirements create markets for grain legumes for feeding livestock. The decision of Bio-Suisse that Bio-Suisse certified ruminants must be fed with feed of Swiss origin exclusively and concentrates will be limited to 5% of the ration from 2022 creates a huge demand for domestic organic feed soy (because of the high protein content).

Innovation in processing technology
Experts agree strongly that innovation in processing technology can increase the competitiveness of local, regional, or European-grown grain legumes (Score 4.09). There is strong agreement that investing in dedicated specialised grain legume processing infrastructure will support a steady supply for different purposes in the food and feed industries (Score 4.26). More education on processing legumes for plant-based foods would improve supply chains (Score 3.86). Experts draw attention to the scope for using new processing technology and related product lines to increase the consumption of legumes. This can be supported by plant breeding for relevant quality traits. On the feed side, a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba bean in particular. The inclusion

rate of faba bean in animal concentrates is still low at less than 2%. There is substantial opportunity to include more faba bean in these rations and diets overall.

Finland for example currently lacks facilities that can process grain legumes. There are existing mills and processors. The problem emerges when handling different grains in an existing system. The mill must assure a clean product i.e. avoid cross-contamination. Processing specifically for grain legumes could be a viable option to pursue. Investment in dedicated grain-legume processing would help ensure a steady supply of material for different purposes in the food and feed industries.

Industry technologists have a poor understanding of processing technologies, especially wet-fractionation. Some advanced processing technologies are kept secret. Educating more process engineers specialised in plant-derived food production would improve supply chains. There is interest in using legumes in the dairy-type aqueous processes, but the constraint is the beany off-flavours of legume ingredients.

Investing in processing technology is constrained by the chicken-and-egg problem. Investment dedicated to specific legumes is very risky. The market share is still too small to invest. The ProLupin example shows that developed an advanced processing technology (for food products) has little impact on the on-farm legume competitiveness.

We need more research on the effects of processing on the nutritional value of pea and faba bean. We also need rapid testing for quality control. Currently there is not trust for home grown legume production supply chain for food production as it does not exist. Will additional costs/investments be rewarded by new market opportunities?

Some experts raise uncertainty about small-scale processing quality as a constraint but overall most are unconcerned (Score 2.83). Similarly, while some experts draw attention to the high requirements of intensive livestock systems, experts generally do not agree that the nutritional requirements of intensive livestock production systems can only be effectively met by industrial feed production (Score 2.50). More agree that the higher per-unit (e.g., per tonne) cost of small-scale processing is not compensated by savings from on-farm use (avoiding the 'middleman'). This constrains legume crop development (Score 3.20).

Consumers

Consumption change

Several experts made the very clear statement that the mega-trend towards reduced livestock product consumption will further increase the demand for food products made from grain legumes. This interest in sustainable consumption will also make the cultivation of pulses more profitable. Such a mega-trend may also reduce the concentration of intense livestock production in some regions (e.g., northwest Europe) reducing nutrient excesses in these regions relieving the pressure on land there. A dietary shift to greater use of plant-based foods will reduce the demand for animal feed and thus reduce the overall demand for protein-rich crops. However, experts strongly agree that the reduced livestock production that may follow consumption change will increase the demand for European-grown legumes making the cultivation of soybean and pulses more profitable (Score 3.73). A reduction in the livestock populations will

increase the scope for growing legumes on farms (Score 3.52) and support a more diverse agricultural system in Europe leading to more legume production and use (Score 3.45). Lower meat production in general will lead to less legume use (less demand for feed). Therefore, only a combined shift (less meat with a higher awareness for regional production) will increase competitiveness. The import of legumes could be reduced, while the production of legumes increases.

However, the extent of consumption change so far has not impacted on the legume production and the trend might not last. The trend needs more momentum to make an impact. Arguably the increased understanding of diets appropriate for advancing age may counter some of these trends as the population ages. Markets are not yet aligned to sustainable consumption patterns.

Novel food products that imitate meat and dairy products are the focus of attention but these are not necessary from a dietary perspective. Consumers will become critical that some of these are highly processed foods. For the typical consumer, the reduction in protein intake in meat and dairy does not necessarily result in a substantial increase in legume use in food products (Score 3.00). In any case, the impact of consumption change on markets for European legumes is constrained by the food industry's access to commodity/imported sources of soya and pulses and the processed ingredients (Score 3.61). They are not especially willing to invest in integrated value chains for these products. Companies like Taifun-Tofu is an exception to this. Few consumers really understand how protein-based value chains work and this awareness raising should not be solely the responsibility of non-government organisations.

There has been a large growth in interest in non-meat based protein products and this has affected attitudes in the farming community, especially with livestock farmers. However, opportunities are being considered by more forward-thinking farmers on how this can be exploited with marketing of more 'responsible' products and promoting the reduced carbon footprint of the products.

The Mediterranean diet, which is regarded as very healthy, shows that pulses are an important part of low-meat diets. Although, citizens in large cities like Athens and Thessaloniki are more influenced from a western type of diet with larger amounts of meat consumption, the rest of the population still uses the Mediterranean diet. However, leguminous crops can be further consumed especially by showing to young people how to work with them in a more up-to-date way. For example, new recipes that match more with modern tastes would be ideal.

Local food

Experts raised a wide range of opportunities arising generally from consumer interest in local food. By 'local' food, we mean food that is marketed on the basis of any differentiation related to origin, including the distinction between European and global sourcing.

Because EU crop production is effectively GM free, the demand for non-GM production increases the demand for European-grown legumes leading to significant opportunities for farmers (Score 3.82). It translates into a premium equivalent to about 100 EUR per tonne for soybean grown according to legal standards in Europe. This premium is due to the higher cost of non-GM soybean on the world market. The market for non-GM milk in particular is a big opportunity to introduce concepts for local feed sourcing. 'Local-food'

brand managers see intrinsic risks to brands in marketing livestock products using local, regional or national identities that in reality depend on long global supply lines, especially for soybean from South America. 'Local' European-grown legumes can offer 'peace-of-mind' in these markets. Legumes with a geographic identity are attractive for the food industry which can pay high prices for key ingredients and qualities (Score 3.14). The impact of demand for local meat and dairy products on legume production is constrained by consumers' lack of interest in feed sourcing (Score 3.74). Consumers are not aware of where feed comes from and labelling to differentiate on the basis of feed sources is required. Even for pea and lentil for food, imports from for example Canada compete with European production.

Local ingredient supply to the food sector is also regarded as an opportunity. Demand for 'local' food increases the demand for locally grown legumes leading to significant opportunities for farmers (3.65). The food industry can pay high prices for key ingredients if the physical, chemical and process quality of ingredients meets their requirements. There is a concern about the supply of locally produced food will not be able to meet the demand of the consumers. Experts generally do not agree that local supply chains are stable enough to provide a reliable supply for food manufacturers (2.09). Consequently, the impact of demand for local legume-based foods on legume production is constrained by concerns about the reliability of supplies for food (3.00) and feed (Score 3.26). In the case of soya for animal feed, commodity soya supply chains are regarded as stable and quality consistent – this combination of scale of supply, resilience of supply chains, and low cost is difficult for value chain managers to reject in favour of local supplies.

Conclusions

What can we learn from this analysis that will help the development of legume-supported value chains? It is important to recognise both the strengths and limitations of the use of the Delphi method. The statements documented above are the result of the systematic assessment of the views of the experts. In many cases, this expertise is formally confined to specific geographic and technical areas and to specific crops. However, most experts have acquired a wider sense of how value chains work. The strength in Delphi is in the resulting collective insight and the identification of what might be and might not be important. It therefore is well suited to the purpose of the Legumes Translated Thematic Network which is to compile, assess and combine existing research and practice-based expertise.

Opportunities

It was immediately obvious from the responses to the open question in Round 1 *('In your expert opinion, what opportunities do you see for legume-related development that impacts on farmers?'*) that experts considered opportunities in relation to whole value chains, from the formation of public policy measures (e.g., the Common Agricultural Policy) through to decisions made by consumers. These of course are interrelated with consumers' views and decisions quickly detected and acted on back through the value chain. The following types of opportunity can be identified:

Where aware, consumers are supportive of change
Experts referred to many examples of consumers' decisions that potentially impact on value chains. The mega trend is a reduction in meat and dairy consumption with a corresponding increase in the consumption of plant-based foods. This in itself would actually reduce the demand for legumes overall, increase demand for food-grade legumes, and possibly reduce livestock pressure on land resources which makes space for crop diversification. The more relevant consumer trend is towards sustainable consumption. The market for non-GM products in some parts of Europe illustrates that diffences in the origin of feed inputs used in livestock production can be used to differentiate products. Non-GM dairy products, i.e., products from dairy production that do not use any genetically modified feed ingredients (GM soya), are now practically standard for the German and Austrian dairy sector. This already improves the competitiveness of plant protein produced in Europe.

Experts indicate that the most relevant and potentially powerful sustainable consumer-related measure is a move towards 'deforestation-free' products. As we have seen with non-GM dairy production, a tipping point may be reached whereby food manufacturers may opt to exclude imported commodity soya from supply chains to protect brands. Consumer-related trends support a positive framework for wider market change.

Citizens support the sustainable development of agri-food systems
By the term 'citizen' we mean individuals as participants in political processes: voters and tax payers. Politicians in democracies are quick to detect and respond to citizens' views, for example recent growing concern about insect decline, plastics, and climate change.

While still only a policy vision and framework, the European Commission's relevant Green Deal strategies, (Farm to Fork and Biodiversity) set out radical agricultural change that is aligned to recent citizens' concerns. These documents influence the development of policy support systems at member state level. The expert panel agreed strongly that citizens as taxpayers are willing to pay for measures that support legume production. Measures such as farm payments for legumes are effective. The political climate is favourable to change. Public concerns about climate change, biodiversity loss, nutrients in water and air, and animal welfare are coming together. Member states' greenhouse gas emission targets and evidence of biodiversity loss dominate relevant public discourse. A consistent direction of travel is emerging: reduced livestock populations in line with consumption change, more diverse cropping systems including legume crops, more attention to the system limits as the use of fertilisers and pesticides is tightened.

Farmers already have access to the required agronomic knowledge and technologies
The study indicates that farmers are willing and able to adjust their cropping systems to include legumes. Farmers are also aware that farming systems are reaching and exceeding biological limits. This is most apparent in the increasing difficulty in controlling grassweeds in cropping systems dominated by cereals. Farmers' decisions are driven by a wide range of factors. Many are about maintaining the economic viability of their business in the short term and protecting the value of assets in the longer term. They respond strongly to financial signals from public policy and from markets. These responses are generally not hindered by a lack of access to relevant knowledge and technologies. Farmers are generally well-placed to deal with biological risks to legume crops: weeds, pests and diseases. There is consensus that farmers are already willing to contribute to the development of legumes if the policy and market signals are supportive.

European legume production and use protects and enhances brands

The sensitivity of European processors and manufacturers to wider societal drivers, especially those from citizens and consumers, is an opportunity. European legume production supports efforts to protect and enhance the image of food products and brands. There is broad understanding that they contribute to farming systems that are more sustainable. There is openness across the value chain to new contract arrangements, particularly where legumes are used for food products. The technologies are available to support local processing and supply chains.

Constraints

Commodity (spot) trading dominates
Panel experts expect that commodity (spot) trading will remain the dominant market force. None of the experts express an expectation that the role of commodity trading will be significantly reduced by alternative marketing arrangements that open up opportunities for legumes. Even with pulse crops such as pea and faba bean used for food, price setting follows those on commodity markets, especially that for soybean and wheat. Policy makers are not in a positon to intervene directly to reduce the dominance of international commodity trading because this would distort international markets and contravene WTO rules. Arable farming in particular is seen as a producer of commodities.

The feed sector in particular is dominated by commodity trading and this is reinforced by the consumers' and citizens' lack of insight into how livestock are fed and the extent of reliance on internationally-traded plant protein.

The continued dominance of commodity trading challenges the view that other trading arrangements will lead to system transition. The responses of experts do not indicate that the dominant cereal-based systems will be challenged just by the growth and merger of a large number of currently niche activities. Such a challenge must be underpinned by fundamentals reflected in commodity trading, i.e., from a shift in the relative basic values of the crop outputs due to changes in relative yields and values in the constituent digestible protein, carbohydrate and oil.

Farmers are committed to specialised and intensive production systems
Farming systems (i.e., the arrangement of enterprises within a farm business) have become intensive and simple. Simple farming systems have advantages in practice. Farmers have adopted simple systems because they reduce overall operating costs and maximise output. Farmers are focused on marginal returns from their enterprise and cropping decisions. The resulting production systems are intensive with for example many dairy herds now managed to produce high yields using optimised diets. The demands on monogastric livestock are even higher. These simple systems reduce capital costs and management time per unit output. They benefit from the use of high-output labour-saving machinery. This is supported on the supply side, for example in the scheduled delivery of precisely formulated uniform high performance feeds. Experts do not see a trend towards reduced production intensity or towards mixed farming that might open up opportunities for legume production and use. This is reinforced by difficulties in assessing real long-term economic effects of diversified cropping and reduced production intensity. There is a trade-off between short term output and long-term farm resilience if a diversification or de-intensification path is taken. Even if diverse farms are adequately profitable and provide good livelihoods, land markets will over time transfer land resources to the most intensive producers.

Integrating policy instruments are not widely used
Public policy instruments, especially regulatory instruments, are generally focused on single outcomes, for example the control of nitrate levels in water. Farming systems remain unaffected by more integrative instruments such as carbon and nitrogen balances, fertiliser taxes, carbon taxes and rewards.

Post-farm processing infrastructure is weak
Processors and manufacturers value the convenience and consistency of processed commodities, especially soya-based commodities. Development of faba bean and pea in particular is constrained by a lack of infrastructure for the first processing steps that will allow harvested crop to be efficiently converted into uniform products in sufficient quantity that can be slotted into existing supply chains. There is a lack of overview of the processing requirements and opportunities in practice.

Current marketing practices do not describe system characteristics
In contrast to the market for organic produce, there are no instruments to enable consumers to connect purchasing decisions with relevant agri-food system changes such as the use of European protein, or more circular and diverse farming systems. The success of organic certification in enabling consumers to support agri-food system depends on organic certification and labelling that consumers generally understand. While some very general labels exist such as 'Red Tractor' or LEAF in the UK and Origin Green in Ireland, or milk from grazed grass in Germany, these do not explicitly relate to protein sourcing or system diversity.

Markets fail to adequately protect public goods
Experts agreed that consumers are not sufficiently willing to pay more for products differentiated by protein sourcing. This reinforces the dominance of commodity trading. Ultimately, the difference between citizens' willingness to support change through public payments and their lack of support for change when making purchasing decisions as consumers reflects the market failure underlying efforts to change agri-food systems.

End note

Increasing the role of European-grown legumes in agri-food value chains amounts to a de-intensification of our agri-food systems. The current European system is enabled by the combination of specialisation in intensively fertilised carbohydrate-rich crops balanced by the import of about 16 million tonnes of plant protein into the EU each year. Developing legumes is one component of a wider change process that will align how we consume and produce food with long-term global and European environmental goals. This system change depends on a wide range of relatively small changes along the value chains all combining to make European legume production and use more competitive at farm level.

Annex 1. Round 1: Experts' responses for opportunities

This document records Round 1 responses of a study of production constraints and opportunities. The work uses a Delphi approach.

Volunteers were invited to join a Delphi panel in July 2020. The panel of 25 experts was finalised on 14 September 2020 (one further expert joined later from outside the consortium). This was the result of an open invitation to all partners in the consortium starting with the Round 1 question.

Experts from the following partner organisations participated: SRUC (UK), HEL (Finland), DMB (Germany), LTZ (Germany), FiBL (FiBL), Teagasc (Ireland), ZALF (Germany), Nireus (Greece), THES (Greece), ABI (Bulgaria), BESH (Germany) (LLH (Germany), Donau Soja (Austria), AST (Ireland), and IFVC (Serbia)

Round 1 question:
In your expert opinion, what opportunities do you see for legume-related development that impacts on farmers?

In relation to each opportunity identified,

What are the circumstances specific to the actor group that make it possible to change cropping or value chains?

What would be the outcome (effect) of exploiting this opportunity for the businesses and the wider value chains involved.

The replies were compiled into this report (Annex 1) and presented to all panel members on 6 October. This documents the responses without revealing the names of the respondents. The opportunities identified by each of the experts are as follows:

Expert 1
Opportunity 1: use of mixed farming circumstances. The opportunity is to diversify crop rotations by including a grain legume as a sole crop or an intercrop in the rotation where there on-farm or local markets for grain as feed. Could apply to monogastric or ruminant depending on choice of legumes, management and growing conditions. This is a relatively simple change in mixed farming situations leading to reduced reliance on imported protein. Choice between grain (combine) harvesting or forage for ensiling depends on equipment on farm or machinery contracting possibilities. This all supports reduction in farm costs, breakcrop effects with environmental effects associated with crop diversification.

Opportunity 2: market incentives for changes to farming systems. These result in payments available for organic conversion or maintenance and price premia on products. This could be products direct for human consumption or a price premium on meat, eggs or milk. These higher prices arise from moving away from a system that depends on purchased fertiliser to one that depends on a crop rotation to provide fertility, weed, pest and disease control. Legumes are an integral part of such systems. Organic is the

obvious example, but possibly also regional "terroir" type schemes based on local production. The outcome is a combinbation of on-farm economioc and environmental effects of increased crop diversity and bilogical nitrogen fixation combined with greater agri-food system resilience.

Opportunity 3: emergence of new niche products and related value chains. New pulse crops or repurpose crops are already being grown for niche food purposes. Scottish salmon is an example. Frontier Agriculture's factory "de-hulls" beans to produce a binding agent for an aquaculture industry looking for a high-protein replacement for imported soya. They are using UK grown beans but using Scottish beans could provide a marketing edge. Another example is Pulsetta (https://www.pulsetta.com/) who are producing gluten free shortbread using pea flour.

BREXIT could push the use of homegrown feedstocks for Scottish livestock production. The "health food" and flexitarian markets are demanding new products – gluten free, vegan etc. All these opportunities tend to use contracts for crop product rather than open market trading. The benefit to the farmer is economic and by growing to contract s/he reduces risk. Also potential value of introducing pulses to the rotation in terms of pre-crop effect, biodiversity etc.

Expert 2

Opportunity 1: consumer demand for locally produced food products. With increased awareness they also ask for regionally grown feed. Soybean is as a protein source an excellent feed. This fuels the demand for regionally grown soybeans.

Opportunity 2: a market for non-GM food products.Consumers are asking for food products with the claim "GM-free". Due to the legal situation in Europe, legal soybean production is non-GMO. Thus the demand for "GM-free" products enables farmers to receive a premium (40-100 EUR per tonne of soybeans)

Opportunity 3: increased consumer demand for food soya products (e.g. tofu), background to this are trends towards vegetarian/vegan diets. This is rooted in a common dietary shift towards less meat consumption as well as more sustainable food. The demand for vegetarian food is often coupled with the demand for regional food. Tofu with European-grown soybeans is now common in supermarkets in some countries.

Opportunity 4: increasing demand for organic food. This is particularly beneficial for soybean production because of the high market price (about 100% on top of conventional price), high yields (yield is as high as in conventional production; unlike cereals) which results in a high gross margin.

Opportunity 5: cropping system limitations reached. Due to increased pest problems, cereal and maize based cropping systems require a break crop to remain productive and competitive. Soybean is appreciated as a break crop in humid continental parts of Europe. Similarly in regions where oilseed rape is the traditional breakcrop,

Opportunity 6: oilseed rape cropping is in difficulty. Due to increased pest, weed and disease problems, winter rapeseed-winter wheat based cropping systems require a break crop to sustain competitivity. Soybean is appreciated then as a break crop. (case in Germany)

Opportunity 7: farmers respond to relevant policy signals and public payments. Historry shows us that provided there is just a modest public payment, farmers respond to measures that can be broadly described as 'greening'. These range from 'coupled' area payments (e.g., in Romania) to eco-schemes under Pillar 2 in Germany that provide whole-farm support for more diverse cropping. These monetary supports have the (sometimes indirect) effect of increasing legume production in Europe.

Opportunity 8: consumers are becoming aware that their food choices have a strong relevance to climate protection. Due to this understanding they are asking for food products with the claims "regional" or "organic" and they also consume less meat. Retailers are responding to these trends and are replacing imported soy from South America with soya from Europe because thereby they can decrease the carbon footprint of e.g. conventional and "gm-free" pork in the EDEKA Hofglück programme in South Germany: claimed carbon footprint reduction by 40 %.

Opportunity 9: the availability of small-scale processing equipment and practical experiences with it are an opportuntiy for regions where soya production and the soya feed value chain are not established yet. Under these circumstances, small scale soya processing equipment enables pioneering farms to create a regional value chain through their own soybeans. (otherwise, these soybeans would not find a buyer for a competitive market price).

Expert 3.

The opportunities in Ireland arise from the combination of very high yields of faba beans, the potential for break crops on arable farms, and the opportunity for import substution for animal concentrate feeds fed to livestock.

Opportunity 1: crop production potential. This opportunity arises from the high yield potential of faba beans in Ireland. Ireland also has a specific research programme targeted at improving yield stability of protein crops, especially beans. Currently, faba beans commonly yield 7.5 to 8.0 tonnes per hectare (however within a large range of 3.0t-9t/ha). At a yield of 7.5t/ha beans are economically competitive against mainstream cereal crops. However the protein payment scheme is still necessary at the moment to protect incomes from the large swings in yields from year to year. Barley is the most widely grown arable crop in Ireland and so is the main competitor.

Opportunity 2: protecting export brands. There is increasing realisation of the need to protect export brands. High value products such as beef, milk products including butter and baby formula are all exported from Ireland as grass fed with a clean, green marketing strategy. Discourse in the media in Ireland, Europe and further afield is questioning these claims because a substantial quantity of animal feed is imported. An estimated 900,000 tonnes of protein (equivalent) are fed in concentrated feeds to Irish livestock each year. There is now a willingness amongst industry participants, especially a number of larger dairy co-ops, to find alternatives to protein imported from outside Europe. There is a national group of industry experts working closely with national organizations to develop the area.

Opportunity 3: opening up of the feed industry to innovation and new feed sources. This opportunity arises because are a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba beans in particular. The inclusion rate of beans in animal concentrates is still very low at less than 2%. There is substantial opportunity to include more fava beans in these rations and diets overall.

Opportunity 4: an expansion of arable cropping in Ireland. The Irish cropping system has the capacity to at least triple the area of existing protein crops (faba beans and peas) within the existing arable land area. Further to this, there is a potential to double the existing arable cropping area of Ireland (to supply more of the overall feed deficit with native grains and displace imports) therefore further potential to increase the native protein crop production.

Opportunity 5: clover. Ireland has as an advantage over many countries as high grass yields are possible year on year. Clover is another potential source of protein for ruminants both in the grazing sward but also as part of the silage diet. Currently an untapped potential for the country is red clover. There is currently some research work in both breeding and developing production systems to include red clover.

Opportunity 6: growing research activity in animal nutrition. There is also a growing research effort into examining the role of all native Irish rations (including the use of beans) and its effect on beef and milk production. These results are ongoing with the initial results looking promising. Messages from these research efforts will support industry to increase the overall level of Irish produced protein in animal diets.

Expert 4

Opportunity 1: more stringent organic certification requirements. The decision of Bio Suisse that Bio Suisse certified ruminants must be fed with feed of Swiss origin exclusively and concentrates will be limited to 5 % of the ration from 2022 on, a huge demand for domestic organic feed soy (because of the high protein content) was created. Bio Suisse supports the domestic feed soy price of 1050 Fr/t with 350 Fr/t to make this crop more attractive to farmers. (The support was formerly funded by skimming of price difference of imported feed cereals, as we approach 100% domestic production, the funding comes from little contribution contributed by cereal farmers, by deducing small amounts of CHF of the producer price)

Opportunity 2: improved available of research-based knowledge. More and more projects are carried out to develop organic production systems and as a result, more extension material is available and extension events take place.

Opportunity 3: market for soy-based organic foods. Since 2013 the organic soybean production increased annually, especially food soy. We have soybean breeders here in Switzerland specialized on food soy. Due to the vegan megatrend bad reputation of soybeans from outside and the usp swissness, relevant tofu producers decided to produce with swiss organic soybeans. Demand is rising steadily.

Opportunity 4: saturated markets for other crops. The markets for other organic crops are saturated. This reduces the competitiveness of other crop options on organic farms.

Opportunity 5: Vegan megatrend stimulates demand for legume based food also other than soy. According to Bio Suisse the production of texturized food with extruders was prohibited (reasons: extrusion is not a gentle process (schonende Verarbeitung), pressure and temperatures used will degrade the food quality to an extend it is no longer considered healthy/natural). However, due to soaring demand a long process of dialogue was started resulting in autorization of extrusion with strong limitations of production parameters per product (temperature, exposure and pressure). Once this process is over, a huge demand for grain legumes for procssing is expected (Lupines, peas etc)

Opportunity 6: New varieties: white lupin varieties appearing on the market with increased tolerance to anthrachnosis disease increase yield stability and competetiveness of this crop. Organic varieties tests show positive results and first farmers report positive yield results too… huge potential. From 2021 on organic avriety tests of grain peas will take place to screen new varieties on the market. New faba bean varieties with low antinutritive compounds stimulate the demand for feed (the feed mills realized that they could increase the share in the products)

Opportunity 7: small opportunity: increasing demand from catering and gastronomy companies for grain legumes, especially special varieties with a history to tell (Pro specia rara, slow food). Breeders, farmers and gastronomy start to cooperate

Opportunity 8: in Switzerland small farms have a comaratively good financial situation due to the great share of subsidies in thei rincome which allows them to do more experiment and spend more time and money in development (Pröbeln)

Opportunity 9: consumers appreciate products of swiss origin, swissness label, and are ready to pay more for it, depending on the product quality.
Constraint for food: cheap imports (better margin for sellers), high price level of domestic products/raw material. Constraint: limited share of grain legumes in the rotation to prevent soil fatigue

Expert 5
Opportunity 1: better and more precise soybean cultivar selection for different environments. One of the first tasks by farmers is the right choice of soybean variety, which will meet the largest number of requests. An important element of successfull production technology is the proper selection of soybean cultivar considering relevant GxExM interactions. A well-functioning seed value chain which addresses market needs brings rewards.

Opportunity 2: soybean in south-eastern Europe. In Serbia, with the production of 220 thousand hectares under soybean; it is well integrated in crop rotation and it fulfill the demands. In other countries in Europe, there is a big potential of integration of soybean in cropping systems. Actor group can offer production technology that will offer producers the possibility of gaining high and stable soybean yield with good grain quality.

Opportunity 3: breeding and production for food uses. Breeding programmes offer many possibilities in creation of soybean varieties taking into account the preferences of its users (processing industry) and to adapt to the demands of the market. Here comes the option of production soybean for human usage and the involvement of wider value chain particpants. There is a big potential for soybean processing and usage for human

consumption in Serbia and neighbouring countries (as final products). There are already existing facilities and products, but it can be extended, what depends on market demand and end users.

Expert 6

Opportunity 1: markets for better process quality, regional and ethical products. If value chains based on added value for the consumer (high animal welfare + non-GMO feed + regional supply) are well communicated (e.g. Hofglück-porc from EDEKA Südwest), they can be successful and develop a growing sales volume for regionally produced soybean … which should be toasted locally (on farm) or in not too big transportation distance.

Opportunity 2: local, small-scale processing. Small toasters on farms (serving also the neighborhood) seem to be a useful strategy for developing regions where there are few buyers of soy. One condition is, that they are well calibrated to deliver correct quality (Donausoja is actually working with Evonik on a survey about existing installations of different types).

Opportunity 3: on-farm agronomic benefits for both organic and conventional. Opportunities for conventional and organic farmers, to grow more soybeans on their farms due to growing outlets as well as due to possible agronomical improvements by optimizing their rotations with a higher share of soy, in case the part of autumn cereals is too high, autumn rape is less satisfying than in earlier years or sugar beet isn't interesting any more.

Opportunity 4: in several states exist subsidies for diverse crop rotations with at least 5 crops and 10% of legumes, which incite for growing more soy as the most rentable legume crop in many regions (but also peas, beans and lupins). As production is growing, the number of acceptance sites of cooperatives and business is also increasing, especially in southern Germany. Since the Straubing based ADM oilmill is ready for producing defatted soybean meal with high protein concentration, the whole range of standard soy products is available also on a base of German soy production. That opens all existing markets for German soy.

Opportunity 5: in the organic sector, demand is bigger than production and prices are very attractive and make soy one of the most rentable crops, as it doesn't need nitrogen input. The marketing organisations of organic labels are buying soybean as soon as the quantity is big enough to fill up a lorry-trailer.

Expert 7

Opportunity 1: substituting imported protein. The biggest opportunity in Ireland for faba beans and any protein crop that can be fed to animals is replacing imported soya, corn gluten and maize distillers. We import over 3 million tonnes of feed, mainly the 3 ingredients above. Demand from the dairy sector for this supplementary feeding is steady, despite all the talk about milk from grass. Concentrate feeding (i.e., mostly using imported protein) per cow may be rising as the opportunities to switch from beef cows to dairy cows declines and dairy farmers increase output by increasing milk yield per cow.

Opportunity 2: demand for non-GM production. Non-GM fresh (liquid) milk is a big opportunity as cows are milked year-round and the concentrate use is therefore higher. This will be a constant demand into the future.

Opportunuity 3: The opportunity to overcome these problems are getting environmental credits for faba beans. This needs a whole industry approach and the protein group is the best vehicle to discuss this, agree a consensus and move forward.

Expert 8
Opportunity 1: the development of red clover. This oportunity arises from a combination of circumstances such as some familiarity with the crop already linked to white clover use. Red clover is an opportunity where farmers want to reduce costs.

Opportunity 2: whole crop peans and faba beans with cereals.

Opportunity 3: lucerne.

Opportunity 4: pea and faba bean for grain. These grow well in some parts of Scotland for human consumption

Opportunity 5: pea and faba bean for forage to reduce feed and fertiliser costs on mixed farms.

Expert 9
Opportunity 1: increasing demand from Mediteranean aquaculture. The ongrowing dynamic of fish farming implies that the requirements of Mediterranean fish feed industry's for plant origin raw materials are constantly increasing.

Opportunity 2: the agricultural exploitation of un-utilised land.

Opportunity 3: the development of certificated industrial units of legumes processing for the production of raw materials for fish feed, with the appropriate qualitative and technical specifications.

Opportunity 4: consumer demand for better process quality, regional products, ethical consumption etc.

Opportunity 5: development of legumes with high protein and low presence of anti-nutritional factors.

Opportunity 6: domestic Legume-based crop rotation programmes.

Expert 10
Opportunity 1: increased local demand for legumes leading to opportunities for farmers.

Opportunity 2: increased interest in local protein self-sufficiency for livestock feeding which supports local crop prices.

Opportunity 3: increased use of production on contract with better trading conditions for farmers.

Opportunity 4: increased interest in improving soil quality, rotations etc.

Opportunity 5: over-winter production of cool season legumes with benefits for machinery use and spreading work-loads, production without irrigation, reduced costs.

Opportunity 6: arable land expansion. Legumes can help farmers restore degraded land to production.

Expert 11

Opportunity 1: farmer demand for more diverse cropping. Current cropping systems are too simple. There are increasing problems with herbicide resistance. Spring-sown grain legumes are particularly relevant. The high breakcrop effect with higher yields and lower nitrogen needs of following crops adds to the opportunity.

Opportunity 2: funding for increased crop diversity under Pillar 2. Individual federal states in Germany are using Pillar 2 (i.e., Pillar 2 eco-schemes) to give payments to farms that diversify cropping. The programmes involve the cultivation of 10% legumes in one year of cultivation. If this type of diverse crop rotation were implemented on all arable land in Germany, it would be possible to grow 1 million hectares of legumes in Germany without crop rotation problems.

Opportunity 3: demand for local/regional feed linked to higher value markets for meat, milk, and eggs.

Opportunity 4: increasing interest arising from German federal investment in knowledge exchange networks, especially the pea and bean demonstration network (DemoNetErBo). The strong public relations work creates an opportunity to integrate very good demonstration farms into the project, to carry out studies on the economy with the demonstration farms, and to integrate all actors along the value chain into the project. When working with the value chain, we benefit from the fact that we do not pursue our own economic interests. We can therefore speak to stakeholders at every level and ensure an exchange of information along the value chain. We can bring our own ideas to the actors, or we can bring ideas from the actors to other actors.

Expert 12

Opportunity 1: improving water management on farms using a rotation of crops with different root architectures. In addition to better use of soil water reserves, a diverse set of crops in rotation can add value to the farming enterprise in different ways. This oportunity is evident in Finland where summers are often wet and where there is many cases poor water infiltration in the soil. When roots die, large biopores are left in the soil, helping rainwater to penetrate, and allowing the next crop's roots to grow. Legumes help to achieve this end as one piece in the puzzle. The internet of things (IoT), with strategically placed sensors on the field or tractors, can help to identify water issues on fields.

Opportunity 2: many faba bean and pea crops respond to inoculation to increase the yield and protein content of grain legumes. While it is often assumed that European crops of fababean and pea do not responde to inoculation, there is evidence that inoculation may be beneficial on sites where these crops have not been grown in the previous

decade. This leads to higher yields with higher protein content and a more reliable and stable market for inoculum makers.

Opportunity 3: using legumes as part of integrated cropping system management to reduce weeds, pests and diseases. Diverse crop rotations disrupt the life cycles of diseases and pests and allow diversification of inputs, reducing the selection pressure on the diseases and pests for resistance to the plant protection methods used by the farmers. With the EU's "Farm to Fork" policy simultaneously reducing the use of plant protection chemistry and blocking the use of science-based breeding technologies, every other method for improving cropping systems needs to be grasped. Broadleaved crops in general allow soil-borne cereal diseases and pests to die, and nitrogen-fixing legumes in particular promote the growth of hydrogen-fixing soil bacteria with plant growth-promoting properties. Wider and more stable production of legumes will provide the raw materials for the growing food and feed industries that make use of them. Improved rotations will reduce the need for some plant protection interventions on the mainstream cereal crops. Diversified rotations will slightly reduce the area sown to the mainstream cereals and hence their production, so the effect of this on the displaced crop's user chain should be planned for.

Opportunity 4: improved on-farm understanding of effective production techniques. There are gaps in farmers' knowledge and more effort should go towards closing local yield and protein gaps. In addition to their experience, farmers will respond to more research-based solutions when making decisions. Few farmers know how to handle any of these crops and our surveys show that they prefer peer-to-peer information flow.

Opportunity 5: improved policy support. Farmers are dissatisfied with low prices for grain legumes. This discourages new producers and weighs down on those who are already producers. An area payment for grain legumes would make a big difference in Finnish circumstances. One calculation shows that a payment as low as the equivalent of 10 EUR/t could be decisive.

Opportunity 6: development of food-crop grading for the trade of grain legumes for food in Finland. Currently grain legumes are undervalued in Finland. There is no food-grade valuation (as provided by Pulse Canada and Pulse Australia) and the feed valuation is based entirely on the value of the protein content with reference to soy. This can be turned around by introducing food grade trade requirements. Grain legumes are sold today based on feed requirements. This would enable farmers to aim for the high-value food market by producing top-grade clean legumes rather than having to be satisfied with the feed value. This will drive production towards ensuring food grade quality and create distinct food-based value chains.

Expert 13

Opportunity 1: breeders can improve quality for food. Currently, processors do not pre-treat grain legumes with heat to prevent off-flavours. While heat treatment is the only processing tool that we have now, other tools may be developed. Breeders can aim to remove seed-borne lipoxygenase in the medium term. Intermediate processors can fill a niche by providing the heat treatment necessary to denature lipoxygenase in beans to be used for wet processes. This opens up opportuunities for small companies specializing in heat treatment who can supply other food-processing companies with certified raw materials. Those processors in turn could focus on favourable sensory attributes when

developing legume derived food products. Breeding can also be used to minimize lipoxygenase activity, as has already been done in soybean and pea, which means removing one technological step and potentially saving costs for businesses.

Opportunity 2: integrated value-chain development of the faba bean and pea-based markets in Finland. Faba bean and pea are the dominant legumes in Finland, partly because these crops grow well in cool climates. Furthermore, faba bean has already attracted the attention of the food industry with strong niche-food products appearing on the market (e.g., Verso Food and Härtelö). Their future could be uncertain if the legume crop production would suddenly be limited and the yearly variation in the quality becomes great. A concered effort to integrate along the value chain would stabilise a range of businesses other legumes such as lupin risk remaining as orphans.

Opportunity 3: investing in more processing facilities for grain legumes. Finland currently lacks facilities that can process grain legumes. There are existing mills and processors. The problem emerges when handling different grains in a system. The mill must assure a clean product i.e. avoid cross-contamination. Processors focussed solely on grain legumes could be a viable option to pursue. Investment in dedicated grain-legume processing would help ensure a steady supply of material for different purposes in the food and feed industries.

Opportunity 4: increase local production of ingredients used in the local food industry. The current price of ingredients used to make plant-based food products is high. The biggest legume-related constraint for most food companies is the quality of legume (faba bean and pea) ingredients available internationally or domestically. Companies producing legume protein concentrates are currently few in Finland. Increasing the supply of consistenly high-quality ingredients for the food industry would have a positive scaling up effect.

Opportunity 5: educating more process engineers specialised in plant-derived food production. Finland currently does not provide adequate education and training of food engineers and technicians, particularly in processing grain legumes through wet fractionation. There is interest in using legumes in the dairy-type aqueous processes, but the constraint is the beany off-flavors of legume ingredients. Finland needs suitable processing engineers in the major processing companies. One way to tackle this issue is to ensure more investment into this line of education. This would mean that value chains would continue to base their perations in Finland with local expertise in the field of high-tech processing.

Expert 14

Opportunity 1: the urgent need for sustainable protein sourcing in Mediterannean aquaculture. Fish farming in the Mediterranean is in an urgent need to identify **sustainable sources of dietary protein**. Legumes have a promising performance so far and they could support further growth of fish production. The import of legumes from places around the globe to support Mediterranean fish farming is based solely on the advantageous price, whereas it comes with a high ecological footprint and limitations in safeguarding quality and sustainable production practices. The commitment to food production with reduced environmental footprint and the actual need of the fish feed manufacturers to exercise reliable quality control in the raw materials have created the circumstances for a change in the supply chain of fish farming. There is a strong belief

that such a change will be appreciated by informed, premium consumers, willing to pay the extra cost of legume production in the Mediterranean. The increasing dialogue for achieving food security at a European level will also contribute towards this direction.

Opportunity 2: diversification of crops and an increase of low-input agriculture will offer wider business options for the Mediterranean farmers that struggle with degraded soils and reducing water volumes for irrigation. The low legume prices and the lack of a structured value chain for legumes of high volume have rendered this option non-feasible. Reliable partnerships across the value chain from farm to fish are essential for planning and growing further. Logistics of low scale that are not vulnerable to global disruption ensure the undisrupted function of the value chain.

Expert 15

Opportunity 1: more effort in plant breeding can increase and stabilise yields. If there were more breeding efforts, yields could increase and get more stabilized. Since having more legumes in European crop shares can be considered a public good, given the benefits for society, research on breeding could be supported by public funding. This could be either done through public research organizations, or, even better, by supporting breeding companies. directly. A justification for such direct subsidies would be that breeding legumes is for now not yet profitable given the small market potential. Companies would need such an incentive to get invested in such markets.

Opportunity 2: policy instruments. From the policy side, any instruments that promotes the use of European legumes can provide opportunities for European farmers. Options are quotas on the inclusion of European-sourced grain legumes in industrially-produced feed (comparable to quotas on biofuels), minimum shares of European legumes in feed concentrates could promote the cultivation of legumes. This share could be slowly increased in order not to over-challenge supply chains from European producers.

Opportunity 3: public payments to farmers for production. The use of crop-specific subsidies is outdated but we know they work from the response to the coupled payments.

Opportunity 4: carbon taxes. Carbon taxes increase the price of nitrogen fertilisers thereby increasing the competitiveness of legume crops.
Opportunity 5: increasing consumer awareness. Fostering public awareness for the importance of having more legumes in EU-agriculture, price premiums for any EU based legume production will have a better standing. Options are campaigns, certification of origin, labels.

Expert 16

Opportunity 1: forage legumes on dairy farms. The opportunity is for dairy farmers to grow more arable forage legumes, with the choice of crop determined largely by local climatic conditions (e.g. red clover versus lucerne). This opportunity arises particularly in farm busineses where the shortening of the resource use chain with associated cost reduction is particularly appreciated because land cultivation decisions and the benefits are linked on the farm – i.e. the choice of which crop to grow rests with the farmer, who also directly reaps the benefit (e.g. lower fertiliser cost, lower feed cost). The outcome for the business (farm) is largely economic, but this contributes to wider societal benefits of resource efficiency and biodiversity. While the benefit to the farmer is largely

economic, the practice could also bring softer benefits in terms of job satisfaction and the sense of positive stewardship of resources.

Opportunity 2: forage legumes in bi-cropping systems on dairy farms. The opportunity is for dairy farmers to grow forage legumes as bi-crops with cereals (e.g., pea/barley mixtures). As with the more traditional use of legumes in the form of grass/clover mixtures, this opportunity can be taken by an individual farmer, provided he has (or has access to) the relevant crop production inputs and machinery. The outcome that matters is largely economic, in the form of reduced feed costs (with the bi-crop substituting for purchased energy- and protein-rich feedstuffs).

Opportunity 3: using pulses as protein sources for dairy farms. The opportunities are (a) for dairy farms to grow pulses (primarily field beans), and (b) for dairy farmers to purchase pulses through the local feed supply chain. This opportunity arises particularly in farm busineses where the shortening of the resource use chain with associated cost reduction is particularly appreciated because land cultivation decisions and the benefits are linked on the farm – i.e. the choice of which crop to grow rests with the farmer, who also directly reaps the benefit (e.g. lower fertiliser cost, lower feed cost). In addition, this opportunity is driven by increasing antipathy to soyabean meal (driven, simplistically, by concerns over deforestation) and concern within the feed industry over over-dependence on rapeseed meal (in light of emerging technical challenges facing growers of oilseed rape). To a large extent, knowledge on how to make best use of pulses (especially field beans) in dairy cow nutrition already exists.

The outcomes that would matter to farmers are (for growers) the development of a local feed market for pulses (to support and underpin existing markets for food and non-ruminant feed) and (for dairy farmers) a general reduction in feed costs (and volatility in feed costs) if their suppliers have more protein sources from which to choose when formulating compound feeds and blends.

Expert 17

Opportunity 1: linking public payments to the use of certified crop inputs. Linking farm payments to conditions for the use of planting material /seeds/ produced in our country or in the region. Compliance with the requirements of the control bodies of the Ministry of Agriculture and Food with production conditions and the approved Bulgarian technologies for growing crops. Only external (foreign) pressure for respecting rules works and result in enforcement.

Opportunity 2: developing local more stable markets. In Bulgaria the market for grain and forage legumes is unstable, and not realized profit for farmers and this will ultimately limits production.

Expert 18

Opportunity 1: developing local markets. Arable legume crops cover about 5% of the arable cropped area in Bulgar where they contribute to the ecological focus area requirements under Pillar 1. These are soybeans, peas, chickpeas, lentils and common beans. Due to the high heat in July and August, some of the legumes fields are not harvested or low yields are obtained. The produced grain - peas and soybeans is usually exported and not processed in our country. Due to the unfavorable climatic conditions and lack of irrigation, the areas with legumes have been decreasing during the last 3

years. These crops are currently not competitive. There are no processing facilities for processing soybeans / due to lack of large quantities over 100,000 tons /. The small quantities of soy produced are used for food or fodder on small farms. The local infrastructure does not provide local markets for the small quantities produced. The soybean market is uncertain, there is a demand for large quantities for export at a low price, which does not bring profit and ultimatelylimits production.

Expert 19
Opportunity 1: supporting technical change with information. The recent history of grain legume production in Bulgaria, especially of soybean, shows production volitility with short-term responses to incentives. The ecological focus area measure in Pillar 1 (2015-2020) requires a farm with more than 15 ha of arable land to have at least 5% maintained as ecological focus areas. Nitrogen fixing crops can be used to contribute to this requirement. During this programming period, there was also coupled support under the protein crop scheme amounting to 2% of the total ceiling for direct payments.
In response, in 2015 soybeans became one of the most popular crops, and Bulgarian cultivars were among the most sought after / along with imported ones which resulted in low yields. The soybean area fell from 34,000 ha in 2015 to 11,100 ha in 2016 to 2,500 ha in 2020. At the beginning of 2015, in order to respond to the growing interest, the Soybean Production Technology book was updated and reissued, which was approved by the Agricultural Academy for market transfer and sale. In 2015, Bulgarian varieties were included in the demonstration platforms of Donau Soja.

Through these new support schemes, as well as through the opportunities provided by Donau Soja, interest in soybeans and other protein and nitrogen-fixing crops should grow, as farmers will have economic incentives to grow them, but in Bulgaria if the farmers do not have a benefit in the first year, it denies them.

The opportunities for enhancement of legumes production in Bulgaria are related to the use of their advantages, along with their more solid support / direct payments/, so that they should become competitive with the imported ones, but the import of soybean and soybean meal has political interests from a long time.

Expert 20
Opportunity 1: exploiting cropping system (rotaton) benefits. Growing of legumes has a positive effect on the total yield of the crops included in the crop rotation. It also reduces producton costs through N fixation and the physical effects on the soil.

Opportunity 2: the production of more livestock products based on feed and forage legumes will have a positive impact on the development of animal husbandry, hence on the employment of the population and will reduce depopulation in rural areas. This has the potential to deliver higher process values (certification etc.) as well as be efficient.

Expert 21
Opportunity 1: consumers' demand for regionally-produced feed that is GMO-free and disconnected to land-use change (e.g., deforestation) in other countries. Added to this, a high concentration of the resulant markets in regions such as north-western Germany – for large local livestock populations and also markets for food-grade legumes in the nearby Netherlands and Belgium mean there is no shortage of markets.

Opportunity 2: public willingness to pay for sustainable whole-farm practices, especially crop diversification. Deep-reaching Pillar 2 (Eco-scheme) payments for diverse rotations are already providing a strong incentive for growing arable legume crops in parts of Germany (e.g*., Nordrhein-Westfalia)*. The experience is growing that this leads to economic advantages for the cropping system as a whole.

Expert 22

Opportunity 1: the EU's new agricultural strategy will promote legume cultivation across the EU but also more nationally in order to achieve the sustainability goal of increasing the diversity of crops and reducing the use of pesticides and nitrogen fertilizers. This will apply to both grain and feed legumes.

Opportunity 2: the demand for legumes grown within Europe will continue to increase, as there is more demand from consumers, in particular GMO-free milk and meat products. This will reduce soybean imports and thus promote the cultivation of legumes within Europe.

Opportunity 3: the marketing channels for grain as well as forage legume products (e.g. alfalfa leaf meal as high-protein feed for dairy cattle and monogastric animals) will be better developed through state subsidies and thus increase sales.

Opportunity 4: the trend towards a vegetarian and vegan diet will further increase the demand for protein products made from grain legumes. This will also make the cultivation of peas and lentils more profitable.

Opportunity 5: the economic evaluation of entire crop rotations, which shows that legume cultivation is already economically profitable because of the high previous crop value and the savings in operating resources in legumes, will encourage innovation-friendly farmers in particular to increase the cultivation of legumes.

Opportunity 6: the decreasing soil fertility due to one-sided crop rotations, which can be counteracted by particularly deep-rooted legumes with an improved humus balance, will promote legume cultivation.

Opportunity 7: the proven increase in agrobiodiversity (insects and field birds but also soil life) of primarily fodder legumes, due to their flowering aspect, soil cover and reduction in the use of pesticides, will increase their political support.

Opportunity 8: as an adaptation measure to climate change, the cultivation of alfalfa in particular (high resistance to drought, good ground cover against wind and water erosion) will spread.

Expert 23

Opportunity 1: the integration of agricultural, environmental (esp. climate), food, and health policy in the EU. Policy integration is a holy grail. It is most evident in the Green Deal Farm to Fork Strategy. While this does not support legume production specifically, it could have far-reaching indirect effects that create a more supportive environment. These include the emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about dietary change.

Opportunity 2: application of the principles of crop physiology to the agronomy of legume breeding and cropping. We know that the increases in the grain yield of cereals in the last fifty years is due to the improvement in how these crops capture resources, especially solar radiation. The most obvious approach is to extend the growing season as was done with the switch to winter cereals. This is relevant for the cool-season grain legumes, especially in south and south-east Europe.

Opportunity 3: nitrogen and/or protein accountancy or balancing at farm and national level. Rigorous farm-gate nitrogen accounting would reduce concentration of livestock production leading to a better connection between livestock and crop production across agricultural systems. This will help increase farmer interest in regional feed supplies. The reduction in nutrient surpluses removes a barrier to legume production in some areas.

National nitrogen or protein accounts are easy to generate and can be used as an indicator for member states under a reformed CAP. This would support a wide range of policy outcomes and address the nitrogen and phosphorus cycles as two seriously exceeded planatary boundaries.

Expert 24

Opportunity 1: cropping system diversification with legumes. Using spring and winter grain legumes as well as perennial forage legumes to diversify cereal-based rotations of the farmers in our AG. This provides benefits of reducing pest, disease and weed pressure (those specific for cereals), providing opportunities for integrating cover crops and spreading work load (different sowing and harvesting time) and risk. In Brandenburg no direct support is available for diversifying rotations and growing legumes apart from the general greening rules (grain legumes, cover crops). Since policy is not sufficiently supporting crop diversification for farmer in the AG, selling opportunities or on-farm use needs to be developed (for the additional crops) to make the changes possible.

Opportunity 2: additional opportunities for marketing and on-farm use of protein crops. There is a high demand for GMO-free plant protein especially soybean that could be met to a larger extent from home-grown legumes in northeastern Germany which is a real opportunity to the farmers in our AG that are profession, large-scale and could produce large amounts of plant protein (if the markets would be existent). Currently, this opportunity is only utilized by organic farmers (soybean for sale, and NL lupin or pea for on-farm use and sale). The cropping systems could be changed to address this opportunity (see Opportunity 1) to some extent but markets are not yet developed.

Opportunity 3: soybean for climate change adaptation (and mitigation). There is an opportunity for growing soybean that can deal better with high temperatures (heat waves) during short periods and utilizes the longer growing periods better than other crops. Farmers in our AG have started to experiment with soy in the recent years and manage it well (conventionally) and still struggle with the weed management (organic). Recent research by ZALF investigates the adaptation of soybean to different climatic conditions to support farmers' decision making, experimentation is ongoing (first results show that heat and short term drought conditions are OK but dry conditions for longer periods in spring have very negative effects on crop development and yield). Mitigation is

not a major concern for farmers but they do see legumes as an opportunity to contribute to reducing the climate impact of their farming (not feeling guilty with current practices but rather doing something good when growing legumes).

Expert 25

Opportunity 1: change in economic and policy framework.

More stable subsidies and market conditions; current state of the livestock sector; level of agro-technical culture of farmers; long-term strategy of the state on the development of the agricultural sector; level of modernization of farms, and conditions in the small Bulgarian villages, etc.

Opportunity 2: exploiting the rotational benefits of legumes, including the soil structural benefits of the perennial legumes.

Annex 2. Round 1: Synthesis of opportunities

This document sets out the results of the analysis of responses to the Round 1 question: *In your expert opinion, what opportunities do you see for legume-related development that impacts on farmers?*

It was obvious that the experts saw opportunities in relation to different stages of the value chain. Therefore, this document summarises the responses in relation to the following stages of the value chain which provided a framework for the remainder of the study:

POLICY
Farm policy
Environmetal policy
Market policy

PRIMARY PRODUCTION – FARMERS
Conversion to organic farming
Agricultural systems change
Farming systems change
Cropping systems change

PROCESSING AND MANUFACTURING
Opportunities from improved quality asessment
Opportunities from brand protection and corporate social responsibility (CSR)
Opportunities from processing technology

CONSUMERS
Opportunities from consumption change
Opportunities from the demand for local food

Policy

Farm policy
The agri-food value chain includes policy makers who set the policy framework conditions in which farmers, processors and other businesses operate and make decisions. In particular, payments, incentives, and requirements under the Common Agricultural Policy have a profound effect on farmers' decisions. CAP policy measures can incentivise the production of grain legume crops directly by providing direct payments coupled to the legume-cropped area, or stimulate them indirectly by putting conditions on whole-farm payments such as diversified cropping. Allowing legume crops to be considered as part of ecological focus areas also stimulates cropping. Specific measures under eco-schemes in Pillar 2 are used in some regions. The new CAP is likely to use national measures derived within a broad EU-wide framework. This opens up the opportunity for national and state-level governments to implement measures that impact on legume production within a wider approach to protein sourcing.

Against this background, experts' responses see positive incentives to produce legume crops as the most powerful policy means to increase legume cropping. These are (i)

straight-forward area payments linked directly to the legume crops to whole farm payments (currently under Pillar 1, e.g., in Ireland); and (ii) payments to farms with that have diversified whole cropping systems with the inclusion of legumes at about 10% of the arable cropped area (currently these are eco-schemes under Pillar 2). Experts report in particular good results from these whole-farm payments, for example in parts of Germany such as *Nordrhein-Westfalia.* These deep reaching Pillar 2 payments are for diversified cropping. A high degree of diversification that exceeds current 'Greening' requirements are rewarded with whole-farm payments. Some experts report that the there is a willingness to pay in society where these payments are made to farmers.

Environmental policy
Environmental policy is the commitment to laws, regulations and public incentives to address the impacts of our activities on the environment. The group put forward five opportunities which relate to environmental policy. These responses indicate that environmental policies are not expected to impact directly on decisions made in legume-supported value chains, but some policy measures may have indirect effects. These are policies on the carbon and nitrogen cycles.

Integrated policy development is a holy grail for policy makers. It is a difficult in practice. The Green Deal Farm to Fork Strategy is a breakthrough in the integration of agricultural, environmental (esp. climate), food, and health policy in the EU. While this does not support legume production specifically, it could have far-reaching indirect effects that create a more supportive environment. These include the emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about dietary change that will create a supportive market both for livestock and plant-based food markets.

The nitrogen and phosphorus cycles have been the subject of EU and national policy since the introduction of Nitrates Directive in the early 1990s. Moving forward, nitrogen (or protein) and phosphorus accounting or balances and protein accounts are easy to generate and can be used as an indicator for member states' progress to objectives under a reformed CAP. This would support a wide range of policy outcomes and address the nitrogen and phosphorus cycles as two seriously exceeded planetary boundaries. Rigorous farm-gate nitrogen accounting would reduce concentration of livestock production leading to a better connection between livestock and crop production across agricultural systems. This will help increase farmer interest in regional feed supplies. Linked to this, the reduction in nutrient surpluses removes a barrier to legume production in some areas. Carbon taxes increase the price of nitrogen fertilisers thereby increasing the competitiveness of legume crops.

Environmental policy on biodiversity is most explicitly covered by the European Commission's recent EU Biodiversity Strategy for 2030 which is also part of the European Green Deal. Only one expert identified policy on biodiversity as an opportunity, and that was related to perennial legumes for forage.

Market policy
Two experts drew attention to opportunity that might arise from market policy. Any policy instruments that promote the use of European legumes can provide opportunities for European farmers. Options are quotas on the inclusion of European-sourced grain legumes in industrially-produced feed (comparable to quotas on biofuels), minimum

shares of European legumes in feed concentrates could promote the cultivation of legumes. This share could be slowly increased in order not to over-challenge supply chains from European producers.

Another softer policy approach to markets is to foster increased consumer awareness. Public agencies can support awareness for the importance of having more legumes in EU-agriculture, price premia for any EU based legume production will have a better standing. Options are campaigns, certification of origin, labels.

Primary production – farmers

This looks at the opportunities that would be acted on specifically by farmers. These are categorised as conversion to organic farming; market opportunities that drive agricultural system change; technological opportunities that drive agricultural system change, changing farming systems; changing cropping systems, and farm opportunities from new technologies and techniques.

Conversion to organic farming
The demand for organic produce is growing. This is particularly relevant because the legumes play a key role as nitrogen-fixing crops on organic farms on one side and are sources of high-value protein with amino acid profiles that complement cereals for livestock feeding on the other. Growth in organic production is particularly relevant because legumes are almost the only managed source of reactive nitrogen into farming systems. A high proportion of legumes are required in arable rotations and legumes and grassland must have a high proportion of clover.

The growth of organic markets has had a particularly large impact on the price and profitability of organic soya. The price of organic soya is about twice that of conventional soya. The fact that organic and conventional soybean yields are similar adds to be economic benefits. Soybean used in organic foods is particularly lucrative especially when combined with other process quality characteristics such as local food.

Agricultural system change
Agricultural systems are the result of the organisation between farms and other enterprises over a geographic region which is characterised by common soil, climate or other circumstances that influence agricultural activity. Action at this level is above the level of individual farms and involves coordination between farms and with other parts of the value chain, including regulators and policy makers. Experts' responses about opportunities at the agricultural systems level are categorised here into market-related opportunities and technology-related opportunities.

Traceable and sustainable protein sourcing is regarded as a major market driver of agricultural system change by many experts. This sustainable sourcing is characterised in particular by reliance on European sources to disconnect agricultural systems from land-use change in South America.

There is increasing interest in substituting imported protein in the dairy sector in particular. For example, the major protein source in the Irish dairy sector is the protein in grass. The quality characteristics of soya are not as relevant to ruminants as they are to

monogastrics, so replacing soya in the dairy sector is relatively easy. Soya is easily replaced by faba bean and pea especially for moderate yielding dairy cows. There is also a growing research effort into examining the role of all-Irish rations (including the use of faba beans) and its effect on beef and milk production. These results are ongoing with the initial results looking promising. These research efforts will support industry in increasing the overall level of Irish produced protein in animal diets.

For monogastrics, experts also highlight potential, but most of these rely on including some soya. This means the pig and poultry sector stimulates demand for the whole range of legumes, including soya. Experts highlight opportunities in aquaculture in particular. Seafood is an important part of healthy diets and markets for fish are particularly sensitive to consumer expectations for traceability and environmental performance. The challenge is to maximise the plant-based proportion of fish diets to minimise the dependence on fishmeal and fish oils. Legumes have a promising performance so far and they could support further growth of fish production. The opportunity is rooted in the expectation that European aquaculture will move from sourcing feed ingredients using international commodity trading to more regional sources based on verified sustainable production practices. The commitment to food production with reduced environmental footprint and the actual need of the fish feed manufacturers to exercise reliable quality control in the raw materials have created the circumstances for a change in the supply chain of fish farming. There is a strong belief that such a change will be appreciated by informed premium consumers who are willing to pay the extra cost of legume production in the Mediterranean. The increasing dialogue for achieving food security at a European level will also contribute towards this direction.

Some experts mention the opportunity arising from increased use of contracts rather than commodity trading. Contracts allow a price to be fixed that the contract parties agree is a fair and allows production to be sustained into the future. Producer contracts instead of open market (spot) commodity trading are particularly relevant for food products and to high value niche livestock products.

Better linking of livestock production to the crop resource base has a positive impact on livestock production and addresses some social problems in eastern Europe. Using legumes can contribute to a trend of moving Europe's livestock sector east to reconnect with the land resource base. This has the potential to deliver higher process values (certification etc.) as well as be efficient.

The development of small-scale processing technology is seen as a very important part of moving towards more diverse agricultural systems that better use local resources. For example, small scale soya processing equipment enables pioneering farms to create a regional value chain through their own soybeans. The equipment needs to be carefully calibrated to guarantee the quality.

Technical opportunities linked to reducing costs or moving to lower cost farming are also highlighted. Moving to a lower cost based includes increasing the use of forage legumes on dairy farms. While this may reduce farm output and turnover, the greater reliance on local resources reduces costs and stabilises the farm economy by reducing exposure to volatile input prices. This leads to more satisfying farming activities and possible higher returns from CSR schemes.

Farming system change
By farming system, we mean the organisation of the individual farm and its enterprises in relation to each other.

Change to lower cost farming systems is raised by a wide range of experts, in particular for dairy production. This includes introducing cereal-legume bi-crops for on-farm feed, introducing forage legumes, and on-farm production of grain legumes. The common driver is the reduction of costs. Greater reliance on farm-produced protein may also be rewarded by certification schemes and protect valuable brands. However, the demand on land on farms with intensive grass-based dairy enterprises was highlighted. The land needs of grass-based dairy production competes on-farm with other land uses, especially since the lifting of milk quotas.

Cropping system change
Experts draw attention to a wide range of technical opportunities at the crop system level. In summary, there is potential for the performance of grain legumes to be improved using technical innovation. Grain legumes are relatively easily adopted by farmers using common farm machinery. Knowledge of effective techniques spreads easily within the farming community. The selection of well-adapted cultivars optimising G x E x M (cultivar (gene) x environment x management) is regarded as the foundation of efficient cropping. Nevertheless, substantial gaps between potential and actual yields remain, due in part to legume crops not being given priority in farm operations, especially where several crops compete for attention at sowing.

The underlying challenge is to increase the competitiveness of legumes compared to other crop options. Experts highlight that other crops have reached barriers within crop systems due for example to grassweeds in winter cereals, yield depressions in oilseed rape and in sunflower are causing farmers to look to other crop options which reduce these crop rotation problems. In addition to rotational effects, several experts mention that some legumes are competitive in cropping systems on the basis of their yield. Soybean is competitive in parts of south-east Europe. Faba bean yields are particularly high in Ireland but this advantage is offset by the fact that the yield of other crops is also high in Ireland.

Experts value the agronomic diversity that legumes bring to cropping systems. This addresses a wide range of problems associated with simplified cropping systems, including resistance to herbicides in grassweeds of cereals. There are also crop physiological effects such as different root characteristics. Some improve water infiltration allowing better use of soils over a rotation. Some legumes also release immobile nutrients such as phosphorus and make them more available for the rotation.

Plant genetic improvement is seen a key opportunity for legumes. Species trait combinations mentioned by experts include increased anthrachnosis resistance in white lupin, reduced levels of anti-nutritional factors and increased protein content for feed, increased yield stability and competitiveness of this crop. Breeding can also be used to improve quality for food products by for example removing lipoxygenase from seed.

If there were more breeding efforts, yields could increase and stabilise. Since having more legumes in European crop shares can be considered a public good, given the benefits for society, research on breeding could be supported by public funding. This could be either done through public research organisations, or, even better, by supporting breeding companies directly. A justification for such direct subsidies would be that breeding legumes is for now not yet profitable given the small market potential. Companies would need such an incentive to get invested in such markets.

While heat treatment is the only processing tool that we have now, other tools may be developed. Breeders can aim to remove seed-borne lipoxygenase in the medium term. Intermediate processors can fill a niche by providing the heat treatment necessary to denature lipoxygenase in beans to be used for wet processes. This opens up opportunities for small companies specializing in heat treatment who can supply other food-processing companies with certified raw materials. Those processors in turn could focus on favourable sensory attributes when developing legume derived food products. Breeding can also be used to minimize lipoxygenase activity, as has already been done in soybean and pea, which means removing one technological step and potentially saving costs for businesses.

Experts also highlighted crop species in themselves as opportunities. These include lucerne and red clover as forage species that fit into arable rotations. Whole crops of faba bean, pea and cereals are also mentioned. The introduction of faba bean itself into rotations in marginal arable regions (Scotland) is also mentioned.

The inoculation of seed is regarded as a very important technology, including for pea and faba bean.

One expert saw an opportunity to improve grain legumes by applying the principles of crop physiology to legume breeding and agronomy. We know that the increases in the grain yield of cereals in the last fifty years is due to the improvement in how these crops capture resources, especially solar radiation. The most obvious approach is to extend the growing season as was done with the switch to winter cereals. This is relevant for the cool-season grain legumes, especially in western and southern Europe.

Processing and manufacturing

Opportunities for improved quality assessment
The assessment of grain quality does not recognise important quality differences, especially for food and higher-grade feed uses. There is no food-grade valuation (as provided by Pulse Canada and Pulse Australia) and the feed valuation is based mostly on the value of the protein content with reference to soy. Trading based on food-related quality parameters would enable farmers to be rewarded for food-grade quality. The same approach can also stimulate and reward production for high-value feed markets, for example aquaculture. This would enable farmers to aim for the high-value markets by producing top-grade clean legumes. This will drive production towards ensuring high grade quality.

Opportunities from brand protection and corporate social responsibility (CSR)
This area is about efforts firms make to meet the expectations of consumers concerning the social and environmental performance of products. This ranges from avoiding scandals through to product differentiation related to environmental and social performance claims. There is increasing realisation of the need to protect brands, especially in exporting countries. The demand for one aspect of quality cascades to others, for example the demand for 'non-GM' leads to demands for more local sourcing generally. The reliance on imported protein threatens to undermine the 'green' image in high-value export markets for products such as beef, milk products including butter and baby formula. For example, an estimated 900,000 tonnes of protein (equivalent) are fed in concentrated feeds to Irish livestock each year. There is now a willingness amongst industry participants, especially a number of larger dairy co-ops, to find alternatives to protein imported from outside Europe. This needs a whole industry approach at the national level with the whole industry moving forward together.

Brand protection also extends to organic certification. More stringent organic certification requirements create markets for grain legumes for feeding livestock. The decision of Bio Suisse that Bio Suisse certified ruminants must be fed with feed of Swiss origin exclusively and concentrates will be limited to 5% of the ration from 2022 on creates a huge demand for domestic organic feed soy (because of the high protein content).

Consumers are becoming aware that their food choices have a strong relevance to climate protection. They are asking for food products with the claims "regional" or "organic" and they also consume less meat. Retailers are responding to these trends and are replacing imported soy from South America with soya from Europe because thereby claiming to decrease the carbon footprint of e.g., conventional and "GM-free" pork in the EDEKA Hofglück programme in southern Germany.

Opportunities from processing technology
Experts draw attention to the scope for using new processing technology and related product lines to increase the consumption of legumes. This can be supported by plant breeding for relevant quality traits. On the feed side, a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba beans in particular. The inclusion rate of beans in animal concentrates is still very low at less than 2%. There is substantial opportunity to include more fava beans in these rations and diets overall.

Finland currently lacks facilities that can process grain legumes. There are existing mills and processors. The problem emerges when handling different grains in a system. The mill must assure a clean product i.e. avoid cross-contamination. Processors focussed solely on grain legumes could be a viable option to pursue. Investment in dedicated grain-legume processing would help ensure a steady supply of material for different purposes in the food and feed industries.

Industry technologists have a poor understanding of processing technologies, especially wet-fractionation. Educating more process engineers specialised in plant-derived food production would improve supply chains. There is interest in using legumes in the dairy-

type aqueous processes, but the constraint is the beany off-flavours of legume ingredients.

Consumers

Opportunities from consumption change
Several experts made the very clear statement that the mega-trend towards reduced livestock product consumption will further increase the demand for protein products made from grain legumes. This interest in sustainable consumption will also make the cultivation of all pulses more profitable. This opportunity is affected by regulation on food processing intensity in the organic sector which limits processing options for legumes in produce meat and dairy analogue products.

Opportunities from the demand for local food
Experts raised a wide range of opportunities arising generally from consumer interest in local food. By 'local' marketing we mean marketing on the basis of any differentiation related to origin, including the distinction between European and global sourcing.

Because EU crop production is effectively GM free, the demand for GM-free products and production systems supports Europe-based supply chains. It translates into a premium equivalent to about 60-100 EUR per tonne for soybean grown according to legal standards in Europe. This is due to the higher cost of non-GM soybean on the world market, compared with standard commodity soya. The market for non-GM milk in particular is a big opportunity to introduce concepts for local feed sourcing. There are intrinsic risks in selling livestock products using some sort of local, regional or national identity where these products in reality depend on long global supply lines, especially for soybean from South America.

Local ingredient supply to the food sector is also regarded as an opportunity. The food industry can pay high prices for key ingredients if the physical, chemical and process quality of ingredients meets their requirements. 'Local' European-grown legumes can offer 'peace-of-mind' in these markets. However, it is recognised that local supply chains are susceptible to local disruptions and quality variability.

Annex 3. Round 2: Scoring of opportunity propositions

This document sets out the propositions for the Round 2 analysis as presented to the panel, along with the mean score and standard deviation. The purpose of Round 2 is to assess the degree of consensus in the group about the opportunities identified in Round 1. This is done in a quantitative way using a six point scoring of propositions or statements generated from the responses to the Round 1 question: *In your expert opinion, what opportunities do you see for legume-related development that impacts on farmers?*

The scores ranged from 'No agreement (0) to very high agreement (5). Based on the Round 1 analysis, statements have been generated for each of the 12 value chain action areas. The 41 propositions related to the value chain as follows.

Policy:	6 propositions
Primary production (Farmers):	19 propositions
Processing and manufacturing:	8 propositions
Consumption:	8 propositions

The participants were given an opportunity to revise their scores based on the mean scores and standard deviations. The presentation of the propositions and the scoring is set out below.

Policy

Farm policy
Policy makers are part of the value chain. They set the framework conditions in which farmers, processors and other businesses operate and make decisions. In particular, payments and requirements under the Common Agricultural Policy have a profound effect on farmers' decisions. Farm policy measures can incentivise the production of grain legume crops directly by providing direct payments coupled to the legume-cropped area, or stimulate them indirectly by incentivising particular approaches to cropping.

The first statement here relates to the traditional payments linked to specific types of crops, called voluntary coupled support (VCS). These are fixed payments per hectare made to the farmer for growing 'protein crops' (grain legumes). They are voluntary because it is optional for member states to use them. Sixteen member states provide VCS to their farmers and payments vary at about 200-300 EUR/ha.

The second statement relates to Pillar 2 agri-environmental measures/schemes (AEM). These are incentives in the European Union (EU) that provide payments to farmers for voluntary environmental commitments. Some member states, notably some federal German states, make payments to farmers who have particularly diverse cropping systems. In North Rhine-Westphalia for example, the AEM provides 90 EUR/ha to farmers who commit for at least 5 years to grow at least five main crops with each covering between at 10% and no more than 30% of the cropped area. The cereal area and the vegetable/horticultural crop are must not exceed 66% and 30% respectively. The area of legume crops, including legumes in forage crop mixes must be at least 10%. A similar

scheme is offered in Baden-Württemberg paying 75 EUR/ha. The phrase 'cost effective' is important in each statement.

1.1	Voluntary coupled payments for legume crops are a cost-effective incentive for legume crop production.					
First response	Number	22	Mean	3.64	Standard deviation	1.22
Revised response		22	Mean	3.73	Standard deviation	0.94

1.2	'Whole-farm' payments for radical diversification of cropping are a cost-effective incentive for legume crop production.					
First response	Number	20	Mean	2.90	Standard deviation	1.55
Revised response		21	Mean	2.57	Standard deviation	1.21

Environmental policy

Environmental policy is use of laws, regulations and public incentives to address the impacts of our activities on the environment. The EC's Farm to Fork Strategy is a breakthrough because of its integration of agricultural, environmental (esp. climate), food, and health policy in the EU. These include the emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about dietary change.

The two statements (questions) here reflect the relevant opportunities expressed by experts in Round 1. With respect to the first statement, the nitrogen and phosphorus cycles have been the subject of EU and national policy since the introduction of Nitrates Directive in the early 1990s. Moving forward, nitrogen and phosphorus accounting or balances are increasingly considered. Mandatory use of lower than optimum nitrogen application rates is now widely discussed.

The second proposition focuses on the other mentioned policy area which is biodiversity.

2.1	Environmental policy on nutrient use and cycling can be a strong driver of legume production and use.					
First response	Number	25	Mean	3.24	Standard deviation	1.48
Revised response		23	Mean	3.35	Standard deviation	1.07

2.2	Environmental policy on farmland biodiversity can be a strong driver of legume production and use.					
First response	Number	24	Mean	3.21	Standard deviation	1.41
Revised response		22	Mean	3.14	Standard deviation	1.04

Market policy

By market policy we mean interventions in value chains to support specific market-related outcomes.

3.1	Regulations on minimum levels for the inclusion of European-grown grain legumes in animal feed could be used to support effectively European legume production.					
First response	Number	24	Mean	4.29	Standard deviation	0.69
Revised response		22	Mean	4.32	Standard deviation	0.72

3.2	Public funds could be used to effectively support public awareness of supply chains and products that use European-grown legumes. Options are advertising campaigns, certification of origin, labels.					
First response	Number	24	Mean	2.75	Standard deviation	1.48
Revised response		23	Mean	2.74	Standard deviation	1.36

Primary production - farmers

This looks at the opportunities that would be acted on specifically by farmers. These are categorised as conversion to organic farming; market opportunities that drive agricultural system change; technological opportunities that drive agricultural system change, changing farming systems; and changing cropping systems.

Conversion to organic farming
The demand for organic produce is growing. Growth in organic production is particularly relevant because legumes are almost the only managed source of reactive nitrogen into farming systems. A high proportion of legumes is required in arable rotations and grassland must have a high proportion of clover. Therefore supporting organic farming means supporting legume production.

So here we are not interested in organic farming itself. We are interested in the wider impact of organic farming. It is about the impact of the growth of organic production on wider legume production and use.

4.1	The growth of organic production can drive legume production and use more widely in agri-food systems.					
First response	Number	25	Mean	3.68	Standard deviation	1.65
Revised response		23	Mean	3.65	Standard deviation	1.40

Agricultural systems change
An agricultural system is the organisation between farms and other businesses over a geographic region which is characterised by common soil, climate or other circumstances.

Question 5.1 is about traceable and sustainable protein sourcing. This sustainable sourcing is characterised in particular by reliance on European sources to disconnect value chains from land-use change in South America.

Question 5.2 is about the increased use of contracts rather than commodity trading. Contracts allow a price to be fixed that the contract parties agree is a fair and allows production to be sustained into the future.

Question 5.3. Pig and poultry production is moving to eastern Europe. This results in better linking of European livestock production to Europe's crop resource base, better nutrient cycling, and employment opportunities in rural areas (as an alternative to emigration to do the same type of work in the West).

Question 5.4 arises from the observation that small-scale processing technology is used in novel local value chains.

5.1	Growing societal interest in sustainable protein sourcing will drive increased legume production						
First response		Number	25	Mean	3.92	Standard deviation	1.04
Revised response			23	Mean	3.96	Standard deviation	0.88

5.2	Producer contracts can replace open commodity trading leading to increased legume production						
First response		Number	22	Mean	3.59	Standard deviation	0.91
Revised response			21	Mean	3.67	Standard deviation	0.73

5.3	Moving Europe's pig and poultry production to eastern Europe could support increased legume production in Europe						
First response		Number	18	Mean	1.89	Standard deviation	1.32
Revised response			18	Mean	1.61	Standard deviation	1.09

5.4	Small-scale processing technologies can play a major role in stimulating local and regional agricultural system changes to increased production and use of legumes						
First response		Number	25	Mean	3.68	Standard deviation	1.35
Revised response			23	Mean	3.52	Standard deviation	1.31

Farming systems change

A farming system is the organisation of individual farms. Change to lower cost farming systems was mentioned in Round 1. This includes introducing cereal-legume bi-crops for on-farm feed, introducing forage legumes, and on-farm production of grain legumes. The common driver is the reduction of costs.

6.1	Moving towards lower cost farming systems is a strong, long-term and real driver behind increased legume production.						
First response		Number	23	Mean	3.39	Standard deviation	1.44
Revised response			22	Mean	3.36	Standard deviation	1.00

6.2	Cereal-legume intercrops/bi-crops are a viable way of introducing legumes for on-farm use on mixed farms.						
First response		Number	24	Mean	2.92	Standard deviation	1.32
Revised response			22	Mean	2.64	Standard deviation	1.05

6.3	Increasing grain legume production is an economically viable option for mixed farming systems.						
First response		Number	23	Mean	3.09	Standard deviation	1.28

Revised response		22	Mean	3.09	Standard deviation	1.11

6.4	There is a strong trend towards mixed farming systems which offer opportunities for increasing legume production.					
First response	Number	21	Mean	2.00	Standard deviation	1.61
Revised response		20	Mean	1.75	Standard deviation	1.21

Cropping systems change

This is about change at the level of individual crops or groups of crops. Change here is ultimately about raising the on-farm performance of legume crops compared with other cropping options. This can happen by improving the performance of legumes themselves or through the decline in the performance of other crops, due for example to rotational problems. Experts also highlighted crop species in themselves as opportunities. These include lucerne and red clover as forage species that fit into arable rotations. Whole crops of faba bean, pea and cereals are also mentioned.

7.1	Legumes compete with, or could compete with, other crop options on farms.					
First response	Number	23	Mean	3.70	Standard deviation	1.15
Revised response		23	Mean	3.83	Standard deviation	0.94

7.2	Declining performance of cereal and oilseed crops provides an opportunity for legumes on farms.					
First response	Number	24	Mean	3.42	Standard deviation	1.59
Revised response		22	Mean	3.59	Standard deviation	0.96

7.3	Legume crops are easily adopted by farmers because the technology and knowhow is available.					
First response	Number	25	Mean	3.20	Standard deviation	1.29
Revised response		23	Mean	3.00	Standard deviation	1.17

7.4	The seed trade provides a good range of well-adapted productive cultivars.					
First response	Number	24	Mean	2.88	Standard deviation	1.48
Revised response		23	Mean	2.61	Standard deviation	1.16

7.5	Plant breeding can significantly improve the on-farm competitiveness of grain legumes compared with other crops.					
First response	Number	25	Mean	4.00	Standard deviation	0.91
Revised response		23	Mean	3.87	Standard deviation	0.97

7.6	Breeding for food quality traits can make a significant impact on the on-farm competitiveness of grain legume crops.					
First response	Number	24	Mean	3.88	Standard deviation	1.15
Revised response		22	Mean	4.00	Standard deviation	0.87

7.7	Breeding for feed quality traits can make a significant impact on the on-farm competitiveness of grain legume crops.					
First response	Number	24	Mean	3.75	Standard deviation	1.07

Revised response		23	Mean	3.91	Standard deviation	0.90

7.8	The performance of pea and faba bean can be increased using seed inoculation.					
First response	Number	20	Mean	3.15	Standard deviation	1.35
Revised response		20	Mean	3.05	Standard deviation	1.10

7.9	The performance of pea and faba bean can be increased using autumn sowing.					
First response	Number	21	Mean	3.19	Standard deviation	1.08
Revised response		21	Mean	3.24	Standard deviation	0.89

7.10	Crop physiological principles (e.g., canopy architecture, light interception, phenology etc.) as used for cereal crops will benefit legume crop development.					
First response	Number	20	Mean	3.50	Standard deviation	1.05
Revised response		21	Mean	3.57	Standard deviation	0.81

Processing and manufacturing

Opportunities from improved quality assessment
The assessment of grain quality does not usually recognise important quality differences, especially for food and higher-grade feed uses. Exploiting more demanding markets depends on more precise quality assessment that recognises top-grade clean legumes.

Question 8.1 is about the effect of more precise quality assessment in general.

Question 8.2 is about related effects on local or regional value chains.

8.1	More precise legume grain quality assessments in relation to high food and feed requirements enables farmers to benefit from high-value markets.					
First response	Number	24	Mean	3.88	Standard deviation	1.15
Revised response		23	Mean	4.00	Standard deviation	0.90

8.2	More precise quality assessment supports the competitiveness of local and regional legume production.					
First response	Number	24	Mean	3.96	Standard deviation	1.27
Revised response		23	Mean	3.96	Standard deviation	0.77

Brand protection and corporate social responsibility (CSR)
This is about efforts firms make to meet societal expectations concerning the social and environmental performance of products. In this context, this ranges from avoiding brand-damaging scandals through to product differentiation using environmental and social performance claims.

9.1	Brand enhancement/protection is a major driver behind increased market demand and prices for locally-grown or regionally-sourced legumes.					
First response	Number	24	Mean	3.54	Standard deviation	1.44
Revised response		23	Mean	3.70	Standard deviation	1.06

9.2	Consumer markets will move towards requiring greater protein self-sufficiency (less reliance on imports) and this will increase farm prices for legume crops.					
First response	Number	24	Mean	3.21	Standard deviation	1.18
Revised response		22	Mean	3.50	Standard deviation	0.91

9.3	Consumer markets will respond to demands for reduced carbon footprints leading to increased farm prices for legume crops relative to other crop options.					
First response	Number	23	Mean	2.87	Standard deviation	1.46
Revised response		21	Mean	3.14	Standard deviation	1.20

Opportunities from processing technology
Experts draw attention to the scope for using new processing technology and related product lines to increase the consumption of legumes in food. This can be supported by plant breeding for relevant quality traits. On the feed side, a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba beans in particular.

10.1	Innovation in processing technology can increase the competitiveness of local, regional, or European-grown grain legumes.					
First response	Number	24	Mean	3.92	Standard deviation	1.02
Revised response		23	Mean	4.09	Standard deviation	0.51

10.2	Investing in dedicated specialised grain legume processing infrastructure will support a steady supply for different purposes in the food and feed industries.					
First response	Number	24	Mean	4.21	Standard deviation	0.72
Revised response		23	Mean	4.26	Standard deviation	0.54

10.3	Educating more process engineers specialised in plant-derived food production would improve supply chains.					
First response	Number	22	Mean	3.73	Standard deviation	1.28
Revised response		22	Mean	3.86	Standard deviation	1.13

Consumption

Opportunities from consumption change

Several experts reported that the mega-trend towards reduced livestock product consumption will further increase the demand for protein-rich food products made from grain legumes. This opportunity is affected by regulation on food processing intensity in the organic sector which limits processing options for legumes in meat and dairy analogue products.

11.1	Reduced livestock-product consumption will increase the demand European-grown legumes making the cultivation of soybean and pulses more profitable.					
First response	Number	23	Mean	3.43	Standard deviation	1.31
Revised response		22	Mean	3.73	Standard deviation	0.94

11.2	A contraction in the livestock sector due to consumption change will increase the scope for growing legumes on farms.					
First response	Number	22	Mean	3.59	Standard deviation	1.10
Revised response		21	Mean	3.52	Standard deviation	0.87

11.3	A contraction in the livestock sector due to consumption change will support a more diverse agricultural system in Europe leading to more legume production and use.					
First response	Number	24	Mean	3.33	Standard deviation	1.09
Revised response		22	Mean	3.45	Standard deviation	0.96

Opportunities from the demand for local food

Experts raised a wide range of opportunities arising generally from consumer interest in local food. By 'local' food we mean food that is marketed on the basis of any differentiation related to origin, including the distinction between European and global sourcing. The demand for 'GM-free' products and a wider interest in products based on local value chains come together. There are intrinsic risks in selling products that have some sort of local, regional or national identity that in reality depend on long global supply lines, especially for soybeans from South America.

The first statement (12.1) is about the effect of demand for 'local' food (i.e., from 'local' value chains and resources) increasing the demand for 'local' legume production.

The second statement (12.2) is about the effect of products that are declared as linked to a geographic origin. This extends from broad categorisation such as 'grown in Europe' to named protected products (protected Designation of Origin or Protect Geographical Indication. Statement 12.3 is about the effect of non-GM labelling and demand.

12.1	Demands for 'local' food increases the demand for locally grown legumes leading to significant opportunities for farmers.					
First response	Number	25	Mean	3.84	Standard deviation	0.75
Revised response		23	Mean	3.65	Standard deviation	0.78

12.2	Geographic origin-based food labels increases the demand for locally grown legumes leading to significant opportunities for farmers.					
First response	Number	24	Mean	3.58	Standard deviation	1.18
Revised response		23	Mean	3.65	Standard deviation	0.65

12.3	The demand for non-GM production increases the demand for locally-grown legumes leading to significant opportunities for farmers.					
First response	Number	24	Mean	3.92	Standard deviation	1.14
Revised response		22	Mean	3.82	Standard deviation	1.01

12.4	Legumes with a geographic identity are attractive for the food industry which can pay high prices for key ingredients and qualities.					
First response	Number	24	Mean	3.29	Standard deviation	1.37
Revised response		22	Mean	3.14	Standard deviation	1.08

12.5	Local supply chains are stable enough to provide a reliable supply for food manufacturers.					
First response	Number	24	Mean	2.29	Standard deviation	1.43
Revised response		22	Mean	2.09	Standard deviation	1.34

Annex 4. Round 3: Experts' responses for constraints

This document sets out the statements/questions for the Round 3 analysis. Round 3 looks at the constraints that are relevant to the opportunities as identified in Round 1 and 2. In Round 3, open questions are asked for each of the 12 value chain themes identified.

Policy

Farm policy
Policy makers are part of the value chain. There is clear consensus in the expert group that payments and requirements under the Common Agricultural Policy (Pillar 1 and Pillar 2) have a profound effect on farmers' decisions. Farm policy measures can incentivise the production of grain legume crops directly by providing direct payments coupled to the legume-cropped area (Voluntary Coupled Support, VCS), or stimulate them indirectly by incentivising particular approaches to cropping. They are voluntary because it is optional for member states to use them. Sixteen member states provide VCS to their farmers and payments vary at about 200-300 EUR/ha. In addition, some member states, notably in some federal German states, make payments to farmers who have particularly diverse cropping systems. In North Rhine-Westphalia for example, the AEM provides 90-125 EUR/ha to farmers who commit for at least 5 years to grow at least five main crops with each covering between at 10% and no more than 30% of the cropped area. The area of legume crops, including legumes in forage crop mixes must be at least 10%. On average experts see the VCS as particularly effective. A small number of experts from regions where whole farm Pillar 2 payments are used (1.2) give this intervention a high score.

Question 1: Voluntary coupled support is used in 16 member states. A few member states or regions use Pillar 2 whole-farm payments for legume-supported diverse cropping systems.

What in your experience is constraining the wider adoption of these direct interventions in cropping decisions?

Expert 1
Price – is there a market? If so can the farmer produce an acceptable yield of a quality product?
Education – does the farmer know how to produce it?
Infrastructure – does the farmer have access to the rigth sort of combine, for example.

Expert 3
Government often have a poor view of tillage and the lack of NGO or others exerting more pressure to increase the direct intervention… do the minimum is often the mantra. Too much regulation and too many places where the farmer can loose money due to increased inspections – re rotations to claim a payment (just to get more legumes into the system) is often seen as an overreach by government telling farmers what to do with all parts of their farm

Expert 6

In Germany agricultural policy, since the abolition of culture specific payments around 2000, doesn't want to interfere any longer in farmers decisions on what to produce and leaves this decision to 'the market' and the farmer as a free entrepreneur.
The experience has prooved that any culture specific subsidies are integrated in the price calculation of the market (e.g. for tabac in Germany, who is payed a lot better than before because the market wants this product and made it survive the abolition of the subsidies; … or soybean prices in Romania, which are quite low because the farmer gets payed partially by the direct subsidies). The payments for diversified rotations are less criticable because they don't adress a specific product (even if some economists of Thünen Institute interpretate it as a specific aid for soybeans … *article of Zimmer and Böttcher in preparation*).

Expert 7
The amount of money. If it is high enough, it is taken up by farmers. Secondly, the system must be simple and adaptable to weather, markets and local conditions. If a subsidy is a tick box with easy to follow rules and has flexibility, it will be widely adapted by farmers. Complicated systems with too many controls will not be adapted. Policy makers must see the big picture and accept wastage of a % of the money. 10% of applicants will be there to get the money only but 90 % will obey the rules. Forget about the 10% and chase the 90% and suit them – don't reguate for the 10%.

Expert 8
The constraints to the wider adoption of these direct interventions as the availability of suitable seed varieities, ingetrating these into the traditional cropping systems and a sustainable market for the product.

Expert 9
The financial sound that especially for the countries of the South do not currently exist.

Expert 11
the large sums of money that have to be used for these measures
in the case of the VCS, ideology is what prevents them, Germany has decided that the VCS should no longer exist. Fear that other crops will then also be coupled again. Fear of overproduction of raw materials that are not needed

Expert 15
Budgetary restrictions definitely will place constraints to such measures.
Even if the money comes from the "big pot" – (the EU budget) – the need for co-financing in the case of AEM (pillar II) can be a tough burden for poorer regions.
Additionally, coupled support in pillar I is not very appreciated under WTO trade agreements. Environmental benefits can be used as an argument, but this could then also be used in other parts of the world, creating another battle on who pays higher subsidies.

Expert 17
Large farmers prefer single area payments without being bound by specific requirements and cropping systems. The reason is that they are oriented towards intensive grain production with low added value. Against this background, small producers are inefficient. In addition, there is no regional link between grain producers, other farmers and processors.

Expert 20
Voluntary double maintenance, VCS is not in the amount needed to compensate for low purchase prices, especially for peas, chickpeas, soybeans. Hence the reluctance of farmers to increase the areas with peas. Peas for the canning industry can be seen in a few areas.

Expert 23
Even though 16 member states have opted to use coupled support to subsidise legume crop production, these payments are constrainted by a number of considerations:

Payments coupled to specific lines of production are contrary to the general direction of agricultural policy over the last 25 years. These payments at up to about 300 EUR/ha are expensive and do not link explicitly to the delivery of public goods. They are also constrained by funding-envelop mechanisms that automatically curtail their impact. Their dependence on political positions make them unstable in the eyes of long-term investors in value chains, for example plant breeders. This all constrains the support for them.

Payments (currently under Pillar 2) for diversified cropping systems are more acceptable to the public in the long term. The benefits include a connection with wider farming system change. This means it follows the principle 'public money for public goods' better. Considering that payments are only about a third of the basic farm payment, there is good value for money. The farm lobby's reluctance to accept payments linked to public goods is a constraint. The switch from direct area-based farm payment to payment linked to environmntal measures and practices is accepted reluctantly. This rejection is evident in the response of Copa Cogeca to CAP reform proposals. A lack of familiarity with whole-cropping system payments is also a constraint.

Expert 24
Interventions affect trade that is maybe not wanted e.g. growing more diverse cereals and legumes may reduce the amout of wheat produced (or other goods for export). More diverse crops may not fit to the very specialised value chains (feed industries), so supporting such measures might result in some neagtive effects for these value chains (or the need to change the value chains, e.g. using local protein crops rather than imported protein).

Expert 25
Administrative capacity and bureaucracy.

Environmental policy
Environmental policy is use of laws, regulations and public incentives to address the impacts of our activities on the environment. The EC's Farm to Fork Strategy is a breakthrough because of its integration of agricultural, environmental (esp. climate), food, and health policy in the EU. These include the emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about the merits of dietary change. Two areas of policy are particularly relevant: nutrient use (Nitrates Directive, regulation of fertiliser use), and biodiversity. The nitrogen and phosphorus cycles have been the subject of EU and national policy since the introduction of Nitrates Directive in the early 1990s. Moving forward, nitrogen and phosphorus accounting or balances are increasingly

considered. Mandatory use of lower than optimum nitrogen application rates is now widely discussed.

Question 2: All farms in the EU are subject to some incentives and regulations that impact on nutrient use and biodiversity.

What is constraining the impact of these measures on the production of legumes in your country or region?

Expert 1
Lack of understanding of the figures needed to assess the nutrient budgets in legume based systems. How much N is fixed, how much N is left behind? Text book figures do not reflect the diversity of reality. Farmers concerned that there are perceived losses of N from legume based systems. In relation to biodiversity, the constraints imposed by the schemes are paramount here. Particularly for grain legumes, the blanket ban on agrohemical use that occurred in some member states put farmers off trying to produce grain legumes.

Expert 3
Prodfitability and stable yield ... legumes viewed as to risky. Clover legumes are not valued in a silage bale and thus not profitable. Increase the yield and stability more will be grown.

Expert 6
In Germany these measures address the fertilisation of every culture individually (e.g. 0 N fertilization to beans, lentils, peas and lupins). On the other hand, organic fertilization is limited to 170 kg N/ha. That means, that in farms with a high charge of animals legumes are not interesting, because you can't apply (nearly) no slurry, manure or compost. To get rid of it, you have to look for supplementary area – which makes the land-prices higher and higher. If, instead these measures would address the N-balance of the farm (N-fertilizer input minus N-export by the agricultural products), this might push (grain) legumes as they are productive also without any N-input and hence reduce the N-surplus which is still around 80 kg/ha and year. This would be an incentive at least outside of the regions with heavy charge of animals. The biodiversity measures instead are not constraining legumes (as long as they don't exceed much 10% on a regional level).

Expert 7
Legumes need to be given more credit for biodiversity in the rules so growing them is rewarded more. There is no real problem on nutrient use. Sometimes the drop in nitogen allowed for the cereal after legume can be too great. Some flexibilty here is nice but it is not a major concern. This would be a good question to ask growers in case they have concerns.

Expert 8
The use of legumes is not promoted sufficiently by industry in general and agronomists at the farm level as a viable alternative to the reduction of nurrient use, especially N. More information is needed for the potential growers of these crops to provide confidence in the successful yields and the advantages of fixed N for the next crop in rotation. Increased confidence in a market for the crops produced.

Expert 9
An additional burden on production costs that may not be absorbed by the sale price
Biodiversity: A very new concept unknown to most farmers. It has probably been shown very superficially but the essence of the concept remains unknown.

Expert 10
Leguminous crops cultivation is a great alternative, especially as a middle crop in order to provide the appropriate N-amounts needed for the following crop. Due to the fact that production of legumes is not input intensive and considering that their cultivation can be feasible even in non-arid fields in some cases, I think that the only constrain is farmers' knowledge.

Expert 11
The farmers lobby
Farmers association

Expert 15
Environmental regulations without compensation are often seen as placing constraints, higher costs and other disadvantages on farmers. For the public budget they are neutral, except for control costs, but such measures, if effective, might push production to other regions. A typical example is the argument about livestock production in northwest Germany. Structural conditions (proximity to ports for imported soy) and smaller farm structures favour pig and poultry production which is claimed to move to less regulated countries. Farmer associations will definitely lobby against any stricter environmtal policies.

Expert 16
There are major changes as a consequence of Brexit, which will take some time to play out. I am not an expert, but in general I expected new UK measures (which may differ among the devolved administrations) to increase incentives and regulations on nutrient use and biodiversity, generally favouring the use of legumes.

Expert 17
Market conditions do not encourage the inclusion of legumes in the crop rotation. Only varieties for intensive production are aggressively distributed, as biological / genotypic diversity is lost in terms of quality, country specific climat adaptation.

Expert 20
The market is the main factor in this regard.

Expert 22
Insufficiently developed marketing and further processing possibilities in Brandenburg hinder legume cultivation in the regionally typical large-scale farms.

Expert 23
For arable crop legumes, the impact of regulations on fertiliser use is constrained by a lack of direct relevance of legumes to efforts to reduce nitrate emissions to water, which is the main target of such regulations.

The use of white clover in grassland is very relevant where fertiliser applications on intensive grassland systems might be restricted, e.g. as proposed for Irish dairy farms. This use is constrained by the reflex reaction against such regulations. It is not in the interest of those who resist such regulation to recognise the role clover could play in mitgating the effect of reduced fertiliser nitrogen use.

The impact of biodiversity related measures on legume use is constrained by a lack of evidence that increasing legume use would have a beneficial effect on biodiversity.

Expert 24
None directly address legumes specifically, so the impact is small. Regulations on N and P lead to changes in crop management (amounts and timing of fertilization, use of cover crops), technology (manure storage, manure application, new fertizers with N inhibitors) and organization (adjustung livestock to the area, exchanging grassland, …). The same crops are grown that are demanded from the market (wheat, rye, oilseed rape, maize for biogass/feed). In some cases, growing legumes could even be seen as negtive e.g. legumes fix additional N, termination of forage legumes releases large amounts of N, less fertilizer is allowed after the legume, when N enters the system from legumes application of additional N is restricted which affects the need for P fertilizer).

The biggest constraint: Policy is focused on single problems with a narror approach e.g. nitrate leaching and does not address it with a systematic appraoch including other issues where legumes could come in.

Expert 25
Insufficient agricultural literacy.

Market policy
By market policy we mean interventions in value chains to support specific market-related outcomes. We have identified two types of market intervention: regulations on minimum levels for the inclusion of European-grown grain legumes in animal feed, and public support (e.g. advertising campaigns, certification of origin, labels) for efforts to raise public awareness of supply chains and products that use European-grown legumes.

Question 3: Based on your knowledge of policy-making in your country or region, what is constraining intervention in markets for legumes?

Expert 1
Not seen as needed when imported soya is cheap. Supply of home grown grain legumes for feed is perceived as variable – in quantity and quality. Also labels of origin, certification etc may be seen by the public as much more important for food than for feed.

Expert 3
Linkage between certified grain and imports not distinguised. Livestock producers ae neither incentivised or decentivised to use native or european groan grains. Nobody is willing to pay more. The isnt central support to drive native is best messages ... consumer is unaware

Expert 6
Interventions in markets for legumes have been always fighted by the representatives of prospering businesses such as importers of oilseeds from overseas (OVID) and the exporters of cereals which are afraid to loose turnover. Also the agribusiness (agricultural commerce, cooperatives, producers of fertilizers and pesticides) normally is not amused because legumes consume less of inputs (resources) than cereals or rapeseed and such reduce turnover as they implicitly reduce the area of other crops. As those stakeholders are well cross-linked to politicians, they are normally constraining interventions in favour for markets for legumes. Only if they are aware of a profitable market niche, they may deviate from this rule (ADM Straubing) and if they are optimistic for further gain (in image), they might even go a little bit further (in order to proof that they really are looking for alternatives to rain-forest devastating soya from Brazil)… and eventually be less opposed to slight moderations of their traditional attitude.

Expert 7
The dairy industry are mean as dirt and do not want to pay for anything other than the cheapest of the cheap. They know the price of everything but the value of nothing.
The dairy industry is too strong to be forced to pay more for native feed and this will have to change. The simplist way is to offer them a choice – reduce stock rates to suit a max carbon or ghg per ha or choose from a suite of options and include native rations amongst this suite. I am 100 % sure most dairy farmers would choose paying €10/tonne more for feed with low level of native protein than de-stock or take on more land.
A stepping stone to this is cert of origin labelling. This would sharpen the whole feed industry if it was implemented and they would see the direction of policy so would allow the market normalise and adjust before having a min inclusion rate of native protein.

Expert 8
A limited understanding of the enironmental benefits of grain legumes, especially for animal feed. There is now growing interest in plant based protein products but more emphasis needs to be placed on the benefits of a local origin to these products.
There are growing concerns for livestock and dairy farmers that the market for plant based protein could be a threat to their production and how this can be addressed.
Increased promotion of locally sources products of a reasonable price or similar price to imported products needs to be considered.

Expert 9
The lack of branded foods that use European-grown legumes.

Expert 10
The biggest limitation is the lack of quantities from an entity (farmer or cooperative) capable of meeting the annual needs of a dairy farm. Moreover, there is no culture of cooperation through contracting, which often makes both parties vulnerable in case of someone does not comply with the spoken agreement.

Expert 11
That would be an intervention in the free market, this is not wanted.
An intervention in the regulation fo supply and demand

Expert 13

For animals the inclusion of European-grown grain legumes has been succesful when used as an extra supply for milking cows instead of soya meal cakes or rape seed meal cakes. In feed sector, it is a balance calculation between the costs of the feed and the benefits for the consumer that can be seen as increased sales of the product. The trend to use these arguments in the consumer marketing has been increasing, and I do not see that it would suddenly stop!

Expert 15
Established value chains create good profits. Any change creates friction and higher adaptation costs. If the feed industry is given enough time to adapt and to negotiate a sufficient supply with farmers, this constraint can be overcome. Constraints to public support for information campaigns can be budget limitations and lobbyism from groups that earn well with the existing value chains.

Expert 16
I don't think policy makers lack information or advice, but lack a framework in which to make interventions.

Expert 17
In my opinion I do not see any interference / support in the legume market in our region and in our country.

Expert 20
There is any constraint for the soybean grain market, but the soy production in Europe as a whole is not so efficient due to need of irrigation. We think the forage pea for grain is a good alternative of the soybean for the animal feeding. There is need for research related to the possibility the forage pea to replace the soybean.

Expert 23
Interventions that impact directly on market decisions are constrained by international rules on trade policy (WTO).

There are no constraints in principle on public support for softer marketing measures such as labelling of origin. Hard identity protection (hard IP) is constrained by the bureaucracy involved but this can be overcome by schemes that reward production without identity preservation (e.g., Donau Soja Protein Partnerships). A major constraint is that most legume crop produce is a farm input (feed). Protein is a hidden input. The feeding stage is at the start of value chains so that even high value certified products such as Parmaham are not required to be based n local protein supplies.

Expert 24
Awareness of the role of legumes for sustainable agricultural systems. Priority to other areas (nutrients, now slowly biodiversity).

Expert 25
Weak competitiveness of domestic products compared to those of third countries.

Primary production- farmers

This looks at the opportunities that would be acted on specifically by farmers. These are categorised as conversion to organic farming; market opportunities that drive agricultural system change; technological opportunities that drive agricultural system change, changing farming systems, and changing cropping systems.

Conversion to organic farming
The demand for organic produce is growing. Growth in organic production is particularly relevant because legumes are almost the only managed source of reactive nitrogen in organic farming systems. Here we are interested in the wider impact of organic farming on conventional farming. We are concerned with the impact of the growth of organic production on wider legume production and use in conventional farming.

Question 4: Based on your knowledge of farming systems in your country or region, what constrains the impact of the development of organic farming on conventional farming?

Expert 1
In the UK organic production isn't really growing. It is often still seen as a niche market and not relevant to "mainstream production". There are pioneer organic farmers doing amazing things but it is often linked to local production rather than bringing about major change. The vast majority of organic ruminant systems in the UK are grassland/forage based. While some import protein, conventional farms are (generally) much more import dependent.

Expert 3
The size of the market in ireland with little or no marketing of organic (beef or Milk) abroad to broaden the base is a huge constraint. When an Irish produicts is alread considered premium then its more difficult to sell premium++ to the consumer.

Expert 7
Dont really understand the question as the development of organic farming has little impact on conventional farming.

Expert 8
The attitude that organic farming is not sustainable and for a fringe market. Lessons learnt from organic producers are not translated to the conventional farmer in a way that promotes both the yields and the environemtal benefits and they are view with suspicion.

The transition period while moving to organic farming is seen a daunting and less productive so a large step to take for many conventional farmers.

Expert 9
The idea that an organic product is better than a conventional one does not convince easily a traditional agricultural people.
A conventional agricultural product which is produced in accordance with rational agricultural practice and with respect to the environment does not lag behind to an organic one.

Expert 10

The largest constrain is the inability of producers to cooperate and gather their production into large amounts, assuring for appropriate quantities for local or national markets. That is the reason why still middlemen play a vital role, gathering the production and gaining the extra value of the whole procedure. Fortunately, local climate permits organic farming without many loses for the producers in the field. Aligning with EU and market rules is the key element for its promotion.

Expert 11
I still not understand. What does the growth in organic farming have to do with a lower use of grain legumes in conventional agriculture? If it the reason of increasing land rent payments then politics must take countermeasures.

Expert 15
Comment: I will answer to following question: Based on your knowledge of farming systems in your country or region, what are the constraints to conventional farming caused by the development of organic farming? Although it is cheaper to replace nitrogen with synthetic fertilizers, in the long run there will be a need to get away from fossil fuel based fertilizers. Therefore, experiences from organic farming can help.

Expert 16
Many practices that might previously have been pigeon-holed as 'organic' have been adopted in conventional farming. Farmers interested in, for example, soil improvement or biodiversity gains can bypass organic farming while adopting techniques that may previously have been confined to organic farming.

Expert 17
The realization of the production is uncertain. Organic production is limited to small areas, there are no regional processors and consumers of organic products

Expert 20
In Bulgaria there is limited demand of biological products due to known reasons

Expert 22
The large size of farms in the region causes a certain reluctance to switch to organic farming. Concerns about marketing problems are in the foreground. The federal support for organic farming and the falling market prices for milk and pig production are currently changing the willingness to convert. In our region, cash crop farms in particular are uncertain whether the conversion is worthwhile.

Expert 23
I do not believe that the expansion of organic impacts on the wider use of legumes.

Expert 24
Prices, they are much higher for organic than for conventional allowing lower yields organic but not in conventional. Markets do not exist (or are very unattractive because of the low prices paid or transport costs need to be paid by farmers) for all legumes when grown conventionally (but organically).

Expert 25
Weak demand for organic products due to low purchasing power of consumers.

Agricultural systems change
An agricultural system is the organisation between farms and other businesses over a geographic region which is characterised by common soil, climate or other circumstances. Experts identified four areas of opportunity to develop legumes at the agricultural systems level. Their constraints are addressed in turn.

Opportunity 5.1 is about the increasing interest in traceable and sustainable protein sourcing, especially protein sources that disconnect value chains from land-use change in South America.

Question 5.1: Based on your knowledge of value chains in your country or region, what constrains how sustainable, 'deforestation free' protein sourcing impacts on the development of European-grown legumes?

Expert 1
Price!

Expert 3
I think the awareness is slowly building but it's not significant yet … people hardly know where milk comes from never mind the proteins the cow is fed. Linking the chain will take a lot of government or NGO interventions

Expert 6
There are three options:
Sourcing of American soy certified 'deforestation free'
Sourcing of alternative protein sources like meal from sunflower, rapeseed or European-grown legumes.
Complying to 'deforestation free' by exclusion of soybeans ('soybean free')

I think, it is a mix of the 3 options. That means, there is a positive effect on European-grown legumes (and on oilseeds – including growing shares of rapeseed from Canada) and there is a challenge to distinguish European-grown soybeans from Amercian-grown soybeans (even 'deforestation free'). Not many European consumers are really aware about the existence of European soy and its potential.

Expert 7
Same answer as question 3. Feed industry like the easy boat of soya, not having to think around native options. Also, the forests burning are too far away from traders.

Expert 8
This is constrained by the promotion of locally sourced produce that would attract the sustainable label. There is currently not the potential to utilise the level of production as it is still at a low level.
The value chains need to be developed from a small and relatively expensive niche market to be incorporated by the larger suppliers.

Expert 9
The low societal interest in sustainable protein
The premium price of a "deforestation free" protein.

Expert 11
soy from deforestation-free supply chains is available in large quantities and there is not much needs to change in the supply change Compared to the use of native grain legumes, the switch to deforestation-free soy is associated with little effort. Only have to select the appropriate certification. There are different definitions of deforestation-free, one have the choice.

Expert 13
It is often negligible or harmful to start to find reasons to grow legumes in Europe saying that agriculture at oversees is bad exploitation of soil and areas. There are so many good reasons to grow versatile crops and take care of our own soil by deep rooted legumes. We researchers should tell straight that we need to change the growing of monoculture grain crops to crop rotation which would provide us healthy soil and enough good, healthy food in Europe instead of criticising other (oversees).

Expert 15
A constraint could be that it is too demanding for consumers to inform themselves on all these facts. Legumes are only a part of a more sustainable production of food. Other elements also play a role, so if a consumer is not an expert in agricultural production, they are lost. This is a reason why organic farming is successful, because it summarizes many benefits in one label. It might not be the most sustainable system in all different indicators, but for consumers organic farming promises the best fit in the search for sustainable products.

Expert 16
Retailers and food processors (e.g. milk processors) are key drivers to reduce the use of imported soya. Constraints on the replacement of soya by rapeseed products (limitations to rape supply) are likely to stimulate the development of European-grown legumes.

However, whereas 'rapeseed meal' is a largely human-inedible co-product of a crop grown primarily for food (oil), pulses are directly human-edible. This may evolve into a barrier to greater use of pulses in livestock. Work is needed to understand the 'amino acid economy' of mixed use of pulses in human and livestock nutrition versus use for humans only.

Expert 17
South America provides a cheap protein resource for feed production. Commercial interest dooms soybean production in our country.

Expert 20
If Europe replaces the use of soybeans in the production of concentrated animal feed, soybean imports from South America will be reduced, which will affect exports there, and farmers will not need to increase arable land in Brazil, which will have a positive effect on the 'deforestation free' there.

Expert 22
The large-scale feed industry in particular has problems with the regionally and annually fluctuating yields and qualities of European grain legumes. In addition, the still low product quantities and the large charges required by the large feed producers lead to a kind of lock-in market situation.

Expert 23
The sectors that depend most on soya from South America are very conservative sectors characterised by commodity trading both for inputs (feed) and outputs (carcase meat, milk and eggs). Efforts to increase process quality are focused on animal welfare.

Even industry players who are well-placed to benefit from a market for 'deforestation-free' products (e.g. the Irish dairy sector) are reluctant to raise awareness. It opens a Pandora's box about how animals are fed.

Lack of a European label for products based on European feed resources. It could be 'From European and deforestation-free feed'.

Lack of understanding in society about how resources flow through agri-food systems, especially in relation to the nitrogen cycle.

Expert 24
No specific demand for regional or EU protein from industries e.g. dairy, meet… especially in conventional but also still in organic value chains.
Consumers do not demand regional protein for the products sufficiently (despite studies showing the opposite e.g. Profeta & Hamm 2019 Do consumers prefer local animal products produced with local feed? Results from a Discrete-Choice experiment).

Expert 25
There is no information accumulated in the country on this issue.

Opportunity 5.2 is about the increased use of contracts rather than commodity trading. Contracts allow a price to be fixed that the contract parties agree is a fair and allows production to be sustained into the future.

Question 5.2: Based on your knowledge of value chains in your country or region, what constrains the development of crop trading using fixed-price contracts for tracable and certified production?

Expert 1
This is massive in the UK for barley (whisky), potatoes, carrots, frozen peas but the market for homegrown grain legumes needs to be bigger for this to develop more widely.

Expert 3
Fixed contracts work well to help farmers to make a margin comparison of proteins to other crops. There is no increased price for traceable or certified production here yet.

Expert 6
On a regional level it's the risk for reselling the contracted legumes nearly one year later: Normally the contracts are made in January/February at a higher price than the commodity-price at that time. But you never know, which will be the commodity price after the next harvest – with which you'll have to compete. That's why regionally traceable and certified legumes are contracted mostly in limited quantity, due to a limited high priced regional niche market. On the other hand, you can make contracts with cooperatives and businesses which can make contracts with an oil mill which bases its offers on the Chicago futures (at least for soybeans). This year this might be attractive,

but the last two years it wasn't. Until now, the big players are less interested in costly certification programs at least as long as non-GMO from Europe is an efficient marketing argument.

Expert 7
The yield variability of legumes is hard to put in a contract unless the buyer pays for a buffer in production to balance shortfalls so the producer sows sufficient. Forcing the market to buy legumes will not work, we need to start with labels to embarrass mills into action and they will respond better. Labels will start the trend and the dialogue amongst users to distinguish and send market signals to the mills. If the market wants native protein, it will happen slowly and then the mills and producers will find a solution to the supply/demand issue and then fixed contracts will be more correct.

Expert 8
There is a level of fixed price contracts for both milk and arable products but these are based on a amount of supply and a quality basis. There would need to be a more recognised or qualified certification process to be able to promote products to the larger suppliers. However, there is a movement towards this in the milk suppliers and their influence on the farmers to use less soya in the cattle feed etc.

Expert 9
The lack of legislation and the complicated bureaucracy. The high fluctuation of raw material prices which creates insecurity.

Expert 11
Fixed price agreements are unusual for the trader and the producer only a small part of the harvest is hedged via fixed prices. Fixed price contracts can be to the disadvantage of farmers.

Expert 13
For many reasons the industry is keen on making contracts with farmers for special crops; gluten-free crops, organic rye and organic oat both for special foods. The chain for legumes is not developed enough in Finland, but I see that the best farmers will be doing contracts with industry for legume crops as well.

Expert 15
Negotiating contracts takes time and efforts. If the benefits from contracts do not outweigh the effort, farmers will not go for it. Legumes buyers also can only offer prices that are derived from the final product price (e.g. meat, processed legume products).

Expert 17
In our region, fixed-price contracts for legumes impose conditions for the use of technology, seeds and pesticides. In fact, these contracts guarantee the profits from the trade in seeds, fertilizers and pesticides.

Expert 20
In Bulgaria we have contracts mainly for wheat, a little for corn, and from legumes only for green peas.

Expert 22

Lack of suitable regional market structures and of amount of output at farm level

Expert 23
The major constraint is the dominance of commodity trading in supply chains. Producers who adopt fixed price procurement need themselves be able to be price makers for their produce. The additional cost at the consumer end is small but the supply chain actors are focused on small changes in the price of large quantities of commodity. It is a wicked problem.

Expert 24
Low risk for companies to use the products. It may take time and money to invest in value chains first and requires the demand from the market (see answers above).

If the demand is there and risk is low, companies can start/increase contract farming e.g. ProLupin is now increasing their demand for regional grown NL lupin because they have established a huge market for their lupin producs (luve) across Europe. Organic traders also use contract farming which seems very positive!

Expert 25
Lack of adequate state policy.

Opportunity 5.3. Pig and poultry production is moving to eastern Europe. This results in better linking of European livestock production to Europe's crop resource base, better nutrient cycling, and employment opportunities in rural areas (as an alternative to emigration to do the same type of work in the West). For legumes, there are two effects: the reduction in nutrient surpluses in western Europe increases the acceptance of legumes in those areas and the increased market for plant protein in eastern Europe may stimulate production for local use there (rather than for grain export).

Constraint 5.3: Based on your knowledge of agricultural system change in your country or region, what constrains the impact of structural change in pig and poultry production on the development of legumes?

Expert 3
Research has shown legumes (faba beans) are suitable for pigs but total production is too small for mills to switch capacity for a small inclusion rates and are unwilling to go there yet. Pig producers are unwilling to tolerate chopping and changing major ingredients in pig diets. A small inclusion of beans may work but in Ireland we need to produce 3-4 times the current volume – consistently each year to be close to regular inclusion in pig rations.

Expert 6
Until now the structure change was driven by cheap protein imports from overseas. So the pig production was reduced in southern Germany and moved to the northwest.
By stressing non-GMO-feeding with soy from Europe, the next structural change might go east – but I see the constraints in sanitary (African swine fever is a major problem in Romania and Poland) and animal welfare aspects, which rise in consumer awareness. Therefore a traceable, certified more sustainable and more animal welfare orientated

production in Western Europe might survive. Which does not exclude, that some low cost production will move to Eastern Europe.

Expert 9
The areas used for pig and poultry farming are small and most of located in semi-mountainous areas.

Expert 11
even if the pig and poultry production moves East, it is not said that they start to feed homegrown legumes. Larger units need more raw materials again, so it is still cheaper to import large amounts of soy than to produce legumes. There is no strategy to decentralise livestock production, although this would be the only way to produce feed and use manure in a cycle. Policies are too weak to steer development towards decentralisation. Livestock units should be linked to area and forage production.

Expert 15
Such changes would come along with high social and economic costs for the regions in the West, where production would decrease. Farmers in those regions have invested in stables and other assets that are sunk costs, if production is no longer profitable. All this would create strong lobbyism in order to stop such trends. From a European perspective, a less spatially focussed production in a few areas would be beneficial.

Expert 16
Economic drivers to reduce use of imported soya.

Expert 17
For social and economic reasons, the livestock sector in our region has collapsed. I do not think that it can be restored without large investments in facilities and automation. In this regard, regional production of legumes cannot develop.

Expert 22
Due to the regional occurrence of the African swine flu, the pig market has nearly collapsed, which has left many pig-producing companies in great economic difficulties, because slaughterhouses and processing plants are very reluctant to accept pigs. I think that pig production especially in Poland and the baltic sea countries will or would have the same problems especially on the international market.

Expert 23
There is huge resistance to structural change in the livestock processing sectors, especially in pig and poultry processing. Processing is concentrated in a few companies that have invested heavily in regions characterised by concentrated livestock production, for example north-west Germany. These companies must ensure that these factories operate to full capacity supplied by local farms, even if these farms are constrained by large nutrient excesses. This situation is strongly defended by local policy communities despite the social ('slave-labour') and environmental consequences.

Especially since much of the labour for these meat processing busineses comes from the east, the case for developing meat production in the east where nutrient excesses are not a problem is strong. The production of 'standard' meat is thus moving east already. However, the impact of this on the markets for feed is constrained by the fact that these supply chains are focused on 'standard' commodity production. These value chains are likely to use imported commodity (GM) soya.

For a destocking of western meat producing regions to have an effect on legume production there, a significant reduction in the value of agricultural land assets is required. This land now commonly costs between 50,000 and 100,000 EUR/ha or 1,500 EUR/ha in annual rent. One driver is the high demand for land for disposing of slurry. These high values linked to the excess of nitrogen drive nitrogen-fixing crops out of the system. These farmers nust grown carbohytrate rich crops that respond to and withstand high applications of slurry. That means growing as much maize as possible.

Expert 24

Expert 25
The livestock sector in the country has been collapsing since the changes in 1989.

Expert 26

Opportunity 5.4 arises from the development of small-scale processing technology is used in novel local value chains.

Constraint 5.4: Based on your knowledge of value chains in your country or region, what constrains the impact of small-scale processing technology?

Expert 1
Demand for niche products based on legumes affects the need/desire to develop this – although this is growing quickly with a rise in consumption of protein alternatives. Only very small areas of legumes grown and mostly for home produced feed so there is a chicken and egg situation.

Expert 6
For me it's the lack of quality control for the on-farm technology. To adjust processing intensity, a rapid test would allow continuous adaption in order to avoid improperly

treated lots which mean bad feed utilization, suboptimal animal performance and therefore economic loss.

Expert 8
The scale of the operations and the machinery that is available for this is limited.

Expert 9
The non competitiveness on costs vs big-scale processing technology and the brand name power of some standard products.

Expert 11
the economics of scale effects
Small processing technology relatively more complex, labour-intensive and expensive than large and highly mechanised units.

Expert 13
Often the small-scale processing technology opens the door s for bigger players. The smaller need guidance for more demanding food technologies, we do not have the guidance for them now.

Expert 15
Small-scale production is only profitable, if this is rewarded by consumers. The majority of consumers might not care too much about this. Therefore, consumer demand limits any growth in this direction.

Expert 16
The technology required to roll or grind pulses for use in ruminant livestock is very simple. Local constraints may include lack of awareness by livestock farmers, lack of access to unprocessed material and lack of local contractor infrastructure.

Expert 20
In Bulgaria there are any small-scale processing technologies.

Expert 22
Due to the regionally large average farm size, small-scale processing technologies are not well suited as marketing channels

Expert 23
The risk of variation in processing quality.
The need for scale in processing crops to feed.
The lack ofg experience with less intensive feeding systems.

Expert 24
It is small-scale so only for small farms, it requires additional efforts/expertise/labour, and the quality is too variable (risk is high to have low feed quality).

Expert 25
Insufficient generation of innovative ideas and
lack of flexible lending.

Farming systems change

A farming system is the organisation of individual farms. Change to lower cost farming systems was mentioned in Round 1. This includes introducing cereal-legume bi-crops for on-farm feed, introducing forage legumes, and on-farm production of grain legumes. The common driver is the reduction of costs.

Opportunity 6.1 is moving towards lower cost farming systems is a strong, long-term and real driver behind increased legume production.

Question 6.1: Based on your knowledge of farming in your country or region, what constrains how the development of lower cost farming systems that make greater use of legumes?

Expert 1
Price – Can the farmer produce an acceptable yield of a quality product that is as good as or cheaper than imported protein.
Education – does the farmer know how to produce it?
Agronomy – particularly the need for early maturing varieties. There is an issue with desiccants in the North of the UK if the idea is to harvest a dry crop as opposed to wholecrop silage – so many now not allowed any more.
Infrastructure – does the farmer have access to the right sort of combine, for example

Expert 3
Low cost farming in Ireland has to be shown to be either less profitable/ similar profitability however with a substantially increased risk (in research trials compared to conventiopnal systems) ... there is no short cuts to crop production. However there is a lack of long term system trials to compare systems. Research funding of 4-5 years is generally not sufficient to realise differences. This may have a role in substantially reduce costs for grazed legume forages/grass mixes. Acceptance of and ability to feed higher quality forages among animal farmers is a constraint. Both research into valuing these forages is needed and also knowledge transfer to help farmers realise these benefits.

Expert 6

I think, it's the uncertainity about food value, due to variable shares of the components in bi-cropping respective the necessity (cost, investment) for seperating the components. The cost advantage in production might be relevant in organic agriculture. In conventional agiculture I see more problems in treatment (fertilization, phyto) and no cost advantage.

Expert 7
Simple – lower cost means no trade interest so no development.
Low cost bicropping will have to be developed by farmers and they dont share info too well despite what people say. Most farmers are private and do not like speaking in public or being in the limelight so on-farm technologies die on the farm they were invented on. The real sharing of new tech is trade personnel picking up info on one farm and gettting another farmer to try it to help his sales. If we rely on low cost to be the driver of

legumes, we are wasting out time. It will be the last thing to drive legumes and will be the slowest thing to happen but it could be useful on a minor % of total farms.

Expert 8
The availability of imformation to grow and incorporate more novel legumes in to cropping roations or to use intercropping in current rotations. The past yields and sustainability characteristics of some of the crops varieties have made farmers suspicious of these crops. New varieties need to be promoted more widely with demonstrations of the crops against the commonly grown crops.

Expert 9
The high operating costs
The small per capita/person agricultural property

Expert 10
Cooperation between single farmers still remains a barrier. Even in the case of profitability, farmers choose to spend more money in order to be independent. They are afraid of sharing their equipment because they do not know what will happen in case of an accident or who will pay for the repair of a damaged machine. Furthermore, farmers have the ambition that "my way, is the best way", not allowing other people's knowledge to change their minds.

Expert 11
Agricultural policy. Monetarily, it is not worthwhile to cultivate legumes.
Otherwise you can save money with legume cropping, but it depends how you calculate your cropping system, if you inculde full costs of your crop rotation, than you can elaborate savings of legume cropping, if you only focus on Deckungsbeitrag, legumes are not competitive against cereals.

Expert 15
Adaptation costs to new systems, sunk costs in specialized equipment for the former farming systems, established thinking of farmers on how production should be ("clean fields, healthy plants")

Expert 16
Complexity brings cost, often in the form of management time (which is often a limiting resource on farm). Convenience and simplicity are major attributes of the service offered by feed compounders and their value should not be underestimated. A compound feed can be a truly complete feed (for monogastrics) or a complete complement for forages (for ruminants). Introducing a protein-rich homegrown feedstuff such as beans means the farmer (and advisor) have to make other changes to livestock diets, requiring time and probably introducing further complexity. Systems that make greater use of legumes must be simple to describe, understand and implement. For example, apparent complexity is an impediment to the adoption of cereal-legume bi-crops. Peer-to-peer knowledge transfer has a key role to play.

Expert 17
In our region, the production of grain, feed and animal products is most often carried out by various economic entities. Therefore, lowering the cost of livestock production is not associated with increased regional production of legumes.

Expert 20
If the farm has livestock, legumes are present, but if it is only for crop production, legumes are almost completely absent.

Expert 22
For grain legumes, the greatest obstacle is the regionally wide range of yield variation up to complete yield losses. Especially in dairy farms, a significant increase in the cultivation of lucerne can be observed due to the very dry last years. There are still no marketing channels for lucerne products on cash crop farms. But production systems for high-protein feed from lucerne leaves or shoot tips are currently being developed.

Expert 23
Lower cost farming is constrained by a lack of understanding of the real economic whole-farm long-term responses of systems to to reductions in production intensity.

Farms in recent years have become highly specialised and focused on optimising relatively simple linear production systems.

Farm businesses have lost an appreciation of the value of economic resilience that a lower cost base brings.

Expert 24
Legumes need rather high input in terms of farming operations (cost of see, weed/pest management, cutting of forages… and are "knowledge intensive") so do not fit to low cost farming. Low cost farming is already used as one strategy on marginal areas (where yields are extremely low), on such soils legumes are not growing well.

Expert 25
Weak transfer of innovation from science to manufacturers. There are ideas but farmers are reluctant to pay for their acquisition.

Opportunity 6.2. This is about the use of cereal-legume intercrops/bi-crops are a viable option, especially on mixed farms.

Question 6.2: Based on your knowledge of farming in your country or region, what constrains how the development of intercrops/bi-crops as viable way of introducing legumes for on-farm use on mixed farms?

Expert 1
Advisors know little about this.
Agronomy – different agrochemicals available for use on cereals and legumes and concerns over disease control.
Agronomy – harvest, will the crop stand and is there suitable machinery to harvest it
EU projects on intercropping are showing how difficult it is to generalise information on intercrop management. It is all about tailoring to local conditions – in part because one crop will always have a competitive advantage over another in a given pedoclimatic niche. So there is a need to understand the principles of intercropping and then apply them.

Expert 3
Some potential for clovers and grass ... little or no research completed for the intercropping grains/forage crops.

Expert 7
Same as 6.1

Expert 8
More information and practical demonstrations on how intercropping can be harvested simply and easily without further investment in machinary or with current contractors machinary. More information on the value and yield of these crops along with calculations of the economic margins.

Expert 9
The dry argicultural areas with low irrigation

Expert 11
There are no marketing opportunities for mixtures
Mixtures only benefit in intern farm use for feed, or you can sell it to another farm directly.
So it needs marketing options for mixtures

Expert 16
See previous answer: complexity (real or apparent). I think farmers (and their advisors) are concerned about the risk of 'falling between two stools', where both crops are not at the ideal stage of maturity at the same time.
Could success in growing legumes as a single crop build confidence to then try intercropping?

Expert 20
Intercrops/bi-crops are used only in large farms. Small farms do not have enough funds for this.

Expert 22
Winter crops are clearly superior to summer crops in terms of yield and security on the regionally sandy soils, together with the often low rainfall during the growing season. Therefore, winter grain legumes would be more suitable for mixed cropping, but the winter hardiness of the existing cultivars is still too low.

Expert 24
Good question, IC was very common in the past e.g. pea-oat and is not used in conventional and hardly in organic farms. Separation is an issue, i) not possible sell when still mixed, ii) separation is expansive, iii) when used for own feed quality varies and requires additional sampling and efforts. In conventional farming fertilization/pest/diseases management is difficult/ impossible (products are not registered for mixtures, they harm one of the component etc.). Research seems to overestimate the potential?? We work now on soy/wheat IC and strip cropping to overcome the negative side of the mixing.

Expert 25
This is a past stage in our country, but with the emergence of modern and strong private farms this practice will be revived.

Opportunity 6.3. This is about the effect of economic viability of legume production on mixed farms.

Question 6.3: Based on your knowledge of farming in your country or region, what constrains the increased production of legumes on mixed farms?

Expert 1
Education – does the farmer know how to produce it?
Agronomy – particularly the need for early maturing varieties. There is an issue with desiccants in the North of the UK if the idea is to harvest a dry crop as opposed to wholecrop silage – so many now not allowed any more. Infrastructure – does the farmer have access to the right sort of combine, for example
Price – is it cheaper to buy feed and produce a more valuable crop with larger yield?

Expert 3
Profitability/yield stability for grain legumes
For grass production ... high N use and weed control tends to decrease clover persistance ... couple this with low pasture reseeding rates nationally and an unwillingness (often unsuccessful) to oversow clover into existing swards ... all reduce the increase use of legumes on mixed farms

Expert 6
Maybe it's the lack of attractive price offers by the common local commerce (besides the problem to get rid of slurry in mixed farms with heavy animal charge).

Expert 7
Lack of technical knowledge of the farmer and their advisor. Mixed farms need very simple solutions as they do not have machines or good advisor support to grow good crops of legumes. Mixed farms have are unlikely to be over mechanised so might fail to correctly establish the bi crop. Often bi crops have poor weed control options so must be drilled in a narrow window and cut in a narrow window to maximise feed quality. They also need good info around pitting and storage and need infrastructure.

Think crimped grain – absolutely fantastic on paper but disaster in practise and never lasts more that a few years on the vast majority of farms. Now if you have 5000 animals and a dedicated arable unit on your farm, you build a long narrow concrete pit. You grow the best crop of winter wheat and pit it. You use second grade urea with water as an additive. Your nutritionalist includes this to the maximum in your feeding wagon mix with waste biscuits, chocolate etc. in this scenario, crimped feed is absolutely the best choice and saves so much money.

Simple solutions like bi crops are generally lower yielding and then the famers have one bad experience and it wipes all the gain from the previous 3-5 years average gains. So then they say ist easier to buy imported soya and keep life simple.

Expert 8
Concerns about the potential sales of the crops to the markets as they haven't been expanded as commercially as possible. The worries of the additional costs of growing legumes in current rotations and any additional machinary costs. The lack of a more developed supply chain for the products.

Expert 9
The availability of irrigation water

Expert 11
The scale of animal production, if you have to much manure / slurry you can not grow legumes because you have to dispose that manure/slurry

Expert 15
The example of BESH shows that only when farmers are obliged by the organization's guidelines to grow legumes, farmers have a need to do this. Normal mixed farms might still buy legumes in the form of feed mix, and grow other crops, esp. cereals for the market.

Expert 16
Access to profitable markets may be a problem.
Agronomic challenges can be a constraint (e.g. persistency of red clover in forage mixes).

Expert 17
The lack of seeds of traditional legumes / vetch and peas / and adapted varieties of them for the production of green fodder.

Expert 20
There is no limit, but they are very few in Bulgaria.

Expert 22
Especially for the regionally typical high milk yield per cow, lucerne leaf material or shoot tips can replace imported soya extraction meal well. However, the production and harvesting techniques still need to be developed and disseminated for this purpose.

Expert 23
The competitiveness of cereals on mixed farms, especially if forage crops or short-term grass lays are in the arable rotation.

The ease of using standard soybean meal as a protein supplement on farms where grain is processed for feeding.

Resistance of the compound feed industry to on-farm feeding.

Mixed-farm businesses often find it more convenient to sell crops 'off-the-combine' than to store and process them to animal feed for their own use. It would help to examine the technology options and costs of on-farm processing in an integrated way – cereals and legumes.

The production intensity of livestock enterprises is too high. There is a strong focus on physical performance at the level of animals, sometimes even individual animals. Livestock are now fed to get the last % of production at the animal level without a corresponding understanding of the economic responses at the whole farm level.

Expert 24
For forages hardly any constraints except fields near the farm. For grain legumes, constraints are feed mills in the region to mix/prepare the feed. Imported protein is still cheaper then growing them on the farm.

Expert 25
Farmers prefer to grow cereals because of the easier and established technology of growing them than the technology of legumes.

Cropping systems change
This is about change at the level of individual crops or groups of crops. Change here is ultimately about raising the on-farm performance of legume crops compared with other cropping options. This can happen by improving the performance of legumes themselves or through the decline in the performance of other crops, due for example to rotational problems. Experts also highlighted crop species in themselves as opportunities. These include lucerne and red clover as forage species that fit into arable rotations. Whole crops of faba bean, pea and cereals are also mentioned. Three sets of opportunities were identified: increasing the relative competitiveness of legumes; adoption of technology; and plant breeding.

Opportunity 7.1. Legumes compete for land with other crop options in cropping systems dominated mostly by cereal species. They also compete with major oilseed crops such as oilseed rape and sunflower.

Question 7.1: Based on your knowledge of cropping systems, what constrains the improvement of the relative competitiveness of legumes within cropping systems?

Expert 1
Combination of price and yield.
How competitive legumes are will depend on the goals of the farmer – for example the desire to be self sufficent. How individual farmers value the competitiveness of the crops will vary depending on what they producing and for what market.
Lack of awareness of the alternatives – crops like red clover and lucerne may not be well known as it may not have been possible to grow them in the past but a combination of breeding and chnagign climate has chnaged this.
Expert 3
On average faba beans can be competitive to other spring crops (not winter cereals) however where beans are affected by drought (the crop is more drought prone) the margin can be extremely poor ... this increases the risk substantially and growers can view the crop as too risky compared to cereals.
Beans and clover based forages are under valued – sale value compared to nutritional status and there appears to be little appitite in the feed industry to change their view... this affects the sales price thus competitiveness

Expert 6
For peas, faba beans and lupins it is the lack of good prices, the restricted genetic progress and the restricted integrability in rotations due to the important distances in the rotation, they have to respect (6-10 years) if you want to maintain them productive. For soybeans profitable commercialisation may also become a problem outside southern Germany, if not cleared before cultivation. Besides soybean needs treatment before feeding – that means costs for processing (and often transport).

Expert 7
2 items
Yield stability of legumes is not good
Low price of legumes relatve to other crops.

Simple to solve. Use labelling and environmental credits to slowly turn the market to native proteins. This will drive a small price increse in legumes and the ag supply market will fix the yield stability problem.
If i know there ill be 20,000 ha of beans demanded in ireland, i will burst myself to get a stable variety. Basf will figure out disease problems to suit their range. Fertiliser companies will solve nutrition problems, drills will be mdified to solve drilling issues.

Expert 8
The methods of successful growing of tese species, especially lucerne in more marginal areas. The best types of soils and the herbicides that can be used to ensure establishment of the crops along with harvesting methods to make certain the maximum yield and protein is harvested and ensiled.

The position of the legume crop in the rotation is important therefore more practical knowledge of the benefits for these crops in fixing nutrients, improving soil structure and overal soil quality.

Expert 9
The unavailability of breeding selection seeds and legume seeds trade.

Expert 10
Although Greece had a relative good relation with leguminous crop production and their consumption, especially after the end of WWII, gradually this relation fade out due to the fact that other cultivations were offering a greater amount of income. That is the reason why most producers cultivated cotton, corn or tobacco. After the economic recession of 2008, many farmers turned to leguminous crops because its cultivation is not input-intensive thus production costs are significant lower. However, it should be underlined that certified seeding material should be developed in a greater extend in order to cover producer's needs. Although national agricultural centres have made efforts for producing new cultivars, a greater promotion is needed.

Expert 11
There is no holisitic view at the cropping system
Profits are always reltated only to the single crop not as a crop rotation

external environmental costs are not included in the high-input farming system, for example: oilseed rape has to be sprayed several times, wheat after wheat has to be sprayed and needs loads of fertiliser.

Expert 15
The price of imported soybeans are the economic benchmark that all changes depend on. Other factors such as "regional", "more sustainable" are only relevant, if they become a part of consumer preferences or if they are shaped into legal instruments. If gross margins of European legumes stay lower than those of other crops, their share in Europe will stay low. Benefits for crop rotations might change this perception, but this will take time.

Expert 16
Use of legumes in rotations depends on the success of intensive cropping systems for cereals and oilseed crops. Disease, restrictions on agrochemicals used on cereals and oilseed crops could create opportunities for legumes.

Expert 17
There is no secure or at least predictable market for legume production.

Expert 20
There is a market for wheat, corn and sunflower for export. Exports for feed peas are absent or very silent. For some legumes the climatic conditions are favorable, for others not - soybeans, fababeans.

Expert 22
Regionally suitable grain legumes such as soybean and pea lack more drought-tolerant and thus more yield-stable varieties. There is still a lack of disease-resistant varieties of yellow and white lupin.
Lucerne see answer 6.3

Expert 23
Reliance on spring-sowing. From a crop physiological viewpoint, the spring-sown cropping characteristic is a constraint both in terms of yield and yield stability in the competition with other cropping options. Winter wheat, barley and oilseed rape are extraordinarily well adapted to most European agri-environments.

Even where spring sown arable cropping is common (spring barley in Ireland, sunflower in south-eastern Europe), there are very good reasons for farmers to continue using those other spring-sown crops instead of spring-sown grain legumes. In particular, hybrid sunflower is extraordinarily well adapted. Part of this is due to the much greater investment in plant breeding linked to the hybrid character which gives breeders a good return on their investments.

The potential biodiversity benefits of retained autumn stubbles over winter that spring-sowning makes possible are not fully understood and recognised. Similarly, the effects of spring sowing on solving weed problems in autumn-sown is not fully appreciated.

Ultimately, cropping systems at being driven to resource and environmental limits. How to create bring systems back into a safer more sustainable operating space is not fully understood or appreciated at farm level.

Expert 24
Yields (they can be lower as others but not as low as currently), prices (esp. in conv. markets), knowledge for the production (choice of varieties, management in the field…) and knowledge for using/selling them.

Expert 25
Their purchase price!

Opportunity 7.2. The performance of the currently available legume crop cultivars can be increased by better seed trading, treatment of seed with inoculants, and adoption of cultivation techniques. Legumes compete for land with other crop options in cropping systems dominated mostly by cereal species. They also compete with major oilseed crops such as oilseed rape and sunflower.

Question 7.2: Based on your knowledge crop production, what constrains the adoption of existing technology to improve the competitiveness of legume crops within cropping and farming systems?

Expert 1
Education and availability of reliable advice.
Lack of good knowledge of impact of cultivation techniques on legume production over time.
Availability of good quality seed – it maybe a constraint for organic production.

Expert 3
For beans there is very little evidence innoculants can make a significnat difference in the field. However research work is needed to confitm if this is true in Irish conditions.

Expert 6
It's the fine-tuning on all relevant steps of cultivation: selecting an appropriate field and variety for the aimed use, verifying sufficient germination rate, inoculating a reliable product (soy and lupin), seeding at the right moment in a properly prepared soil, efficient weed regulation, supervision in case of upcoming problems, harvesting at the right moment, ideally with a flexible cutting bar (soy).
Expert 7
The yield stability is too naturally variable so its hard to say what tech will make a big difference and often all the tech we have will fail to stop a yield depression in a dry year. The only thing stopping tech getting into beans is the lack of return for your investment ie the area of beans is not enough to attract the big investment like in wheat or barley.

Again, if the area of legumes increases all the tech companies will be interested and decide if they should be involved or not.
Build it and they will come!

Expert 8
The competitiveness of legumes would be improved by more higher yielding cultivars and those that are more sustainable with a pasture sward for forage. There is a view that red clovers in a mixed sward are out competed after only a few years and the benefits are lost, or in as a sinle species sward their productivity decreases after only 4 years.

More information the production of mixed cropping sprecies i.e. pea and barley and the methods for successful cultivation especially as a whole crop for forage. The timing of sowing and harvesting etc.

Expert 9
The Yield of legumes per ha vs cereals and oilseed crops which results to higher production costs.

Expert 11
cheaply produced nitrogen and a lot of pesticides do not create an incentive to change anything in the crop rotation. This leads to crop rotation being neglected as a type of crop production technology, because only with a holistic crop rotation approach do legumes pay off. New technology like chopping technique is expensive

Expert 17
Technologies must take into account the regional resource security, ie developed and disseminated regional technologies and practices.

Expert 20
The same as in 7.1. In addition, the biological characteristics of legumes.

Expert 22
Regional suitable existing technologies are already adopted or are currently being taken over especially by the organic farmers. For conventional farmers there is lack of professional advisory service.

Expert 23
There are no particular constraints on the adoption of existing technologies currently available to farmers and value chain businesses. These crops use conventional existing farm machinery and knowledge of how to produce them is freely available. Experience shows that farmers who want to adopt new crops and technologies readily do so if they are available.

Expert 24

If legumes are grown, then most of the available technologies are usually used (recommended varieties, inoculation when needed). Constraints remain that such technologies are easily available, a lack of knowledge and high costs e.g. for specialized machinery or irrigation (compared to low prices). There is still a research gap what

technologies are really the best and can increase yields (weeding, micro nutrients, direct seeding).

Expert 25
Insufficient financial incentives for legume producers.

Opportunity 7.3. The future competitiveness legume crops can be increased through the genetic improvement of species – plant breeding. This starts with using crop physiology to frame target traits (especially for yield), breeding for food quality traits; breeding for feed traits.

Question 7.3: Based on your knowledge crop production, what constrains the explotation of potential of plant breeding? Please mention where relevant constraints on specific opportunities as well as the constraints on plant breeding in general.

Expert 1
The size of the market is a major constraint in terms of legumes being minor crops that are not receiving large investments.
Yield, quality and disease resistance are major breeding targets for grain legumes.
There is a widespread perception that the yield of grain legumes is inherently unstable but not so much robust evidence.
Adaptation to Northern climates –need for cold tolerant and early maturing varieties.

Expert 3
For beans
There is not a specific breedng program targeted at maratime climate needs – and specifically Irish needs. Although some research work (in Oak Park Carlow) has been completed to identify varieties which are more suitable to Ireland, however there does not seem to be an appetite from breeders to utilise these results (yet) .
Overall the area of beans/peas is too smal in Ireland for a specific breeding program or more targeted breeding - we try to utilise the most suitable varieties from various breeding programmes designed for other countries
Areas which need more work include yield stability and disease tolerance

Huge progress could be made in red clover varieties (close to a 30% yield gain from a small breeding effort in Ireland) is possible.

Expert6
In general, plant breeding for crops with a small acreage and where the yield can easily be used for sowing it next time again (non-hybrid seed) are not very attractive for investment in breeding.
Soy is in advantage as it is an important crop worldwide and has got decoded its genome the last few years, which enables smarter (marker-based) breeding. As soy is an attractive product for feed and food that has a positive perspective in Europe, it‘s better served by breeders than the other legumes (but by far not as much as cereals, corn and rapeseed).

Expert 7
Feed traits like low vicine in beans has taken 30 years to become common in standard cultivars. The traits are very risky as the feed market must pay a premium to encourage more investment by breeders, however the feed market can take the traits for granted also. What the traits can do is make beans more mainstream so increasing the overall area and return to the breeder. Gene editing will help as with all crops. I do not have sprecific knowledge on how fast or slow genetic progress is in beans but the breeding goals of the big breeders is yield stability, harvest stability and protein content. Special traits for feed are a lower priority.

Expert 8
Plant breeding is a long process (over serveral years) and so the breeders need to be sure of the traits that are important to sell the seed after that period are valid.

A lack of communication with the plant breeders and the end users of the most important traits.

Needs more communication with the farmers who would potentially grow the varities to ensure they have confidence in the crops yield and sustainability (if part of a forage mix).

Expert 9
The lack of seed selection centers, for Greece at least.
Few experts deal with this subject

Expert 10
Is the limitation of producers to align with production protocols
It is very difficult to persuade dairy darm owners to make changes in their ratios in fear of changes on the quality characteristics of the produced milk
Generally real-case experiments are the greatest way to persuade both sides that this small value chain can be profitable or all stakeholders involved.

Expert 11
It is still a small sales market for grain legumes
So the input of money and labour is still low, but with an increase of money and labour in breeding, breeding will speed up. This does not even require any biotechnological processes.
but it is interesting to see how the relatively small increase in acreage has led to an increase in available varieties.
In order to increase interest and input in breeding, it is essential to increase the area under cultivation. This may also put the large sums of money spent on agri-environmental measures into perspective. Because the development of better varieties will be a sustainable measure

Expert 16
Agronomic traits seem to dominant the plant vreeding agenda, with little attention given to traits relevant to nutritional value (here thinking about nutritional value for livestock). For example, more attention is needed to improve the amino acid profile of pulses.

Expert 17
In the case of cereals and legumes, it is necessary to stabilize the yields through plant breeding in respect of for early maturity / soy / and winter hardiness / vetch, peas, faba bean /.

Expert 20
There is no serious demand for legume varieties due to the small areas they occupy.
Small areas, little interest in the selection of legumes.

Expert 22
Especially for lupines there is a lack of plant breeders in Germany. There is only one!!

Expert 23
Fundamental market failure. Grain legumes are relatively minor and in-bred species. This means the market for seed is small and the flow of royalty income is not secure. This leads to under-investment in breeding, especially in pre-competitive pre-breeding activities.

Fragmentation in the pre-breeding effort. Pre-competitive pre-breeding is hardly organised in any way. This means that the connections between public academic research in relevant genetics and the genetic improvement of the crop are tenuous.

Academic research is organised by disciplines to serve particular genetic technologies while breeding is crop species specific. Many large research projects do not efficiently articulate generic academic questions into species specific breeding.

Publicly-funded research is dominated by academic interests. Academic outputs are still the driver behind much of the public research activity. Research users (breeders) are not in charge.

Some public plant breeding activities are still conditioned by the belief that environment/region-specific breeding programmes are needed. It is argued that the whole parent maintenance and selection effort, the crossing, the establishment of lines and finaly the selection of lines as new cultivars must take place in the environment in which the cultivars will be grown. In short this means that the generation of genetic variability (cross) is directly linked to the selection from that variability, all in the target region. A more systematic approach is required that separates crossing from selection for different environments.

Expert 24
The traits required are complex, e.g. drought tolerant varieties, resistance to diseases… and very specific for each legume species and hence difficult to achieve (quickly and cost effective) with breeding. Breeding in legumes is generally too little compared to what we aim for (a protein transition) and reflects the little market share and expectations for changes in that marked (except for breeding in soy).

Processing and manufacturing

Opportunities from improved quality assessment
The assessment of grain quality does not usually recognise important quality differences, especially for food and higher-grade feed uses. Serving and benefiting from more demanding markets depends on more precise quality assessment. More precise quality assessments enables markets to recognise and reward production that better meets the needs of high value food and feed markets. Examples include legumes with precisely measured low levels of anti-nutritional factors used in fish feed and legumes that better meet the needs of manufacturers of novel plant protein-based foods.

Opportunity 8. The economic viability of legume cropping can be increased by using more precise quality assessment to recognise and reward the higher quality that better meets the special needs of high value markets.

Question 8: Based on your knowledge crop production, what constrains the adoption of more precise quality management within legume-based value chains to generate premia over commodity prices for high-quality production.

Expert 3
As mentioned in previous sections correctly assessment of the nutritional components of beans and other forage legumes is needed but this also needs to be translated into action by the industry and ultimately the farmer

Expert 6

On soy the problem is, that special properties for use as food (taste, mouth-feeling/structure of the food product) are difficult to measure by chemical/physical analysis. Finally you have to test it in production and make a decision for a special variety. For high-quality production therefore contracting the chosen variety with farmers is the solution. Also in feed production it might be advantageous to select a range of varieties that meet the quality you are looking for in order to get a more homogenous stock that does not need a separation in lots of different quality (e.g. protein concentration).

Expert 7
There is a lack of connection between the feed industry and higher value end users. The end users are specialised in their markets and were used to soya not other sources. Certainly, meeting personnel from the end user industries helps bridge this gap. Also, more environemtal credits will encourage the feed industry to seek out more sustainable feed options. Labelling will encourage this.

Expert 8
The lack of marketing od higher quality products and the explanation of the advantages, especially if they are more expensive.

More information on why higher quality is better for the consumer or a company that uses the products as an ingredient.

Improved methods of quickly establishing the quality of a product using a recognised certified method.

Expert 9
For feed the intense competition from animal by-products and by-products of other oilseeds. Quality parameters such as low presence of anti-nutritional factors cannot claim a better price in a feed sale contract.
For food, I really don't Know, but I guess that it is the same status as feed.

Expert 11
small market and low quantities
Which qualities are needed for which processing methods are still unknown and unexplored.
For example, there is a lot of information in the literature on antinutritional ingredients and there is also constant talk of antinutritional ingredients in agricultural extension, but there is no precise information on which antinutritional ingredients are still acceptable and in what quantities. These ingredients do not play a role for peas and field beans. Knowledge about the ingredients is still too imprecise. This lack of precision also applies to the quality properties of starches and proteins in legumes. But fortunately there are now some research projects on this.

Expert 13
The knowledge of the quality issues of legumes is needed for food sector, the lack of the whole chain is the main issue.

Expert 15
Costs for developing new equipment.

Expert 17
The evaluation of the quality of the grain is performed by the processors. Quality above certain standards is not encouraged by the purchase price.

Expert 20
There are any constrains in this regard.

Expert 23
The availability of the necessary quality testing techniques at the level of trading. Also, there is generally a poor understanding of quality common to growers and users.

Expert 24
Not a very important constraint in the moment except maybe for lupin and their alkaloids, this is really problematic and not yet understood (effect of genotype, environment, management).

Expert 25
There is no differentiated payment.

Brand protection and corporate social responsibility (CSR)

This is about efforts firms make to meet societal expectations concerning the social and environmental performance of products. In this context, this ranges from avoiding brand-damaging scandals through to product differentiation using environmental and social performance claims.

Opportunity 9. There is consensus between experts that brand protection and corporate social responsibility will support legume production in Europe. These range from brand enhancement and protection, exploiting increased consumer interest in sustainable protein sourcing in Europe, and consumer demands for lower carbon footprints. These can be grouped together under the term 'sustainable consumption'.

Question 9: What constrains the development and exploitation of markets that serve sustainable consumption that supports European legume production?

Expert 3
A lot of work to educate the broad base of population about the cost of food versus sustainability. Also a lot of work to align SUD policy (reducing tools) with trade deals and the willingness to accept imports which are grown using tools banned in Europe. Reduce the imported GM prodcuts (and very unsustainabily grown soya/maize) would improve the competitive edge and consumption of EU grown proteins.
It's a whole EU policy shift not just trying to educate consumers!

Expert 6
I see two aspects:
The demanding challenge for smaller companies to make up a proofed CO2-footprint balance of its products.
The demanding challenge to organise the supply with beans every year by contracts with farmers – which have to be located in different regions due to the risk of insufficient yield caused by drought.

Expert 7
Policy makers afraid of being too influential in the market.
End users are not encouraged to change because the purchasing trends of consumers is based on price not sustainability. Soya and maize has been the biggest driver of cheap food for my lifetime. Huge farms can profitably grow starch and protein that is used in every food we eat. It is produced the same way on all the continents and trade is so well established, it is easy to correct shortages in one area with surplus from another area. Corn flour, corn syrup, soya oil, soya meal, maize distillers grains, corn gluten are the same the world over. Gm varieties use the same herbicide all over the world. The ony thing that changes across the world is the ripening date to suit the climate.
So it will be a huge change to trade to use faba beans or lentills or peas or chickpeas to replace corn or soya. We can only grow faba beans in ireland so a surplus of chickpeas in spain is no good to us as we have not processed them. And if we do process them and like them, we cant grow them. So surplus deficit trade will have more friction.

Expert 8

A feel that local markets are more important i.e. individual countries or regions than Europe as a whole. Brand protection again needs to operate at a regional level as why import from Europe if the products can be grown here?

Expert 9
The real value of sustainability has not been yet clarified in the public. It seems more like an extra financial burden with no immediate impact.

Expert 10
As it was mentioned before, there is a shortage of large amounts in leguminous crops. That is the reason why leguminous crop producers do not have an advantange. Altough as in every situation there are exceptions, here is another one:
https://www.agrifarm.gr/?portfolio_categories=legumes
On the link you can find the exact opposite of the previous mentioned statement.

Expert 11
Cheap meat production is an constrain to sustainable consumption
the use of homegrown legumes increases the price of meat
meat substitutes based on legumes are relatively expensive

Expert 15
Limited attention by consumers. Too many ways to act sustainable.

Expert 16
Soya supply chains (direct to food and indirect via animal feed) are largely invisible to the final consumer – therefore he/she sees little value in developing alternatives.

Expert 17
It is neccessary to look for ways to connect with the consummers different than advertising.

Expert 23
The encumbency of commodity based value chains is the major constraint. Even leaders of value chains that could benefit are sometimes reluctant to 'rock the commodity boat'.

Lack of a label or brand that links the sourcing of plant protein in Europe to sustainable value chains in the eyes of the consumer.

Premia from 'sustainable' branded products are not passed back efficiently to farmers.

Expert 25
For our country - its general backwardness. However, in economic terms it is in last place in the European Union.

Opportunities from processing technology

Opportunity 10. Several experts draw attention to the scope for using new processing technology and related product lines to increase the consumption of legumes in food. This can be supported by plant breeding for relevant quality traits. On the feed side, a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba beans in particular.

Question 10: From your knowledge of legume-supported value chains, what constrains innovations in processing technology that increase the on-farm competitiveness of legume crops?

Expert 3
For beans there needs to be some research or infrastructure support for processing at compound mills. In Ireland beans will always be a small component of rations due to our supply issues so feed mills are reluctant to have dedicated bins specifically for the beans.

There should be more research to investigate if toasting can improve ruminant protein bypass of beans also

Expert6
In the case of soybeans it is the need for investments combined with the lack of rapid quality tests for the optimal setting of the machinery in order to get reliable good quality.

Expert 7
Dont really know much about this

Expert 9
Expensive investments with a long payback period especially for the animal feed manufacturers.

Expert 11
The procession technique is still not available, and also the recipies to manufacturise products.

Expert 13
The change will happen gradually and we will have a legume value chain beside other crop value chains. The production of legumes should be supported so that the risks are not too high for farmers to learn to grow legumes. Then the industry learns to trust that they can get quality legumes for their innovations and technology. Now there is not trust for home grown legume production supply chain for food production as it does not exist.

Expert 15
Will additional costs/investments be rewarded by new market opportunities?

Expert 16
Speaking from ignorance, but I'd expect the current frenzy over 'plant-based diets' to drive innovation in processing that is relevant to European-grown legumes.

Expert 20

There are any constrains in this regard.

Expert 23
The volumes required remain low.

The technology to match crop quality with precise requirements is missing.

Expert 24
The marked share is still too small to invest. The examples of ProLupin that developed a very advanced processing technology (for food products) showed that the impact on the on-farm legume competitiveness was so far still very minor, this might change. A complex topic…

Expert 25
Lack of traditions. Weak competitiveness of products imported into EU countries.

Consumers

Opportunities from consumption change

Opportunity 11. Several experts reported that the mega-trend towards reduced livestock product consumption will further increase the demand for protein-rich food products made from grain legumes. This opportunity is affected by regulation on food processing intensity in the organic sector which limits processing options for legumes in meat and dairy analogue products. Such a mega-trend may also reduce the concentration of intense livestock production in some regions (e.g. northwest Europe) reducing nutrient excesses in these regions. A dietary shift to greater use of plant-based protein-rich foods will reduce the demand for animal feed and thus reduce the overall demand for protein-rich crops.

Question 11: What is constraining the impact of consumption change on the competitiveness of legume production in Europe?

Expert 1
Not all of the consumption change relates directly to legume production. There are many other crops that can provide protein for human consumption.
The magnitude of change in diet needs to increase and be sustained for it to work through the chain to European legume production.

Expert 3

The trend to less animal protein is happening to what extent this will translate to a large reduction in consumption is less clear. The flexitarian diet may become more popular thus the entire demand for proteins will decrease. Arguably the increased understanding of diets appropriate for your age may supersede some of these trends (more protein as we get older). Developing plant protein rich food products that rival meat based products continues to be a challenge but large food processors are making inroads.

However, this will not get over the challenge of making these foods highly processed and thus not as healthy as they could be.

Expert6
I would say, it's the price payed for the legumes at farm level. The profit of the food producer should be better shared with the farmer – and if it would be on a basis for supplements for the better quality of legumes, that would give a signal for qualification that is helpful for the whole value chain (e.g. paying system of Taifun-Tofu explained in brochure 'Erfolgreicher Vertragsanbau':
https://www.sojafoerderring.de/wp-content/uploads/2015/01/Broschuere-Erfolgreicher-Vertragsanbau-2017.pdf)

Expert 7
I think this mega trend will be like biomass and peak oil in 2007 – it might fade away when the millennials grow up and have to feed a family

Expert 8
The availability of the products. There has been a large growth in interest in non-meat based protein products and this has affected attitudes in the farming community, especially with livestock farmers. However, opportunities are being considered by more forward-thinking farmers on how this can be exploited with marketing of more 'responsible' products and promoting the reduced carbon footprint of the products. Familiarising consumers with these products, however, there are active marketing and advertising campaigns that are starting not address this.

Expert 9
The silly idea of reduced consumption of animal protein and dairy products. Even if this idea prevails, there is the on-growing bio-economy of aquaculture that can offset and keep the correct balance.

Expert 10
Mediterranean diet (MD) highlights the role of legumes as a meat substitute. There is an old quote that "Beans are the meat of the poor", signifying their importance in someone's diet. Although, citizens in large cities like Athens and Thessaloniki are more influenced from a western type of diet with larger amounts of meat consumption, I believe that the rest population in the countryside, still respects the basic guidelines of MD. However, leguminous crops can be further consumed especially by showing to young people how to work with them in a more up-to-date way. For example, new recipes that are matching more with modern tastes would be ideal.

Expert 11
No, it is not only the regulations of production for organic products. It is also the consumers' demand not to have a long list of ingredients and to have only a few ingredients that indicate industrial processing. In addition, it is not yet known whether the highly processed products such as extruded protein isolates have anything to do with the actual nutritional and physiological benefits of legumes.
Food tradition is maybe also a constraint - there is no tradition of using legumes in the diet, or it has been forgotten. Legumes in nutrition are not valued.

Expert 13
Difficult question, needs a lot of slow corrections in our food and feed chains and policy that would correct the false, too low (supported, subsidised) costs of meat and dairy production, the meat and dairy product prises are now too low which does not benefit anybody. It doe not guide the consumer to make corrections in his diet and think other options which obviously would be more legume products. We have good examples of the low income, higly populated countries that follow more environmentally and nutritionally balanced food production and diet like India and Egypt where the basis of the diet is on legumes and other vegetables and grains. The "Planetary Health Diet" by the EAT-Lancet Commission should be used strongly to promote the awareness of need for the change in agricultural policy.

Expert 15
Lower meat production in general will lead to less legume production (less demand for feed). Therefore, only a combined shift (less meat with a higher awareness for regional production) will increase competitiveness. The import of legumes could be reduced, while the production of legumes increases.

Expert 16
Processing innovation (see Q10)?

Expert 20
It is not observed in Bulgaria. Meat consumption is high.

Expert 23
The changes in consumption have been relatively small so far.

For the typical consumer, a moderation/reduction in the consumption of livestock does not require switching to high-tech meat and dairy analogue products.

Once the use of grain legumes in these products becomes mainstream, these manufacturers will switch to commodity purchasing.

These products /value chains will be subsumed into the conventional agri-business commodity-based trading systems.

Few consumers really understand how protein-based value chains work.

Expert 24
Consumption change in terms of eating less meat does not mean more legumes, even the opposite (less forage, grain legumes fed to livestock).

Expert 25
Consumer literacy.

Opportunities from the demand for local food

Opportunity 12. Experts raised a wide range of opportunities arising generally from consumer interest in local food. By 'local' food we mean food that is marketed on the basis of any differentiation related to origin, including the distinction between European and global sourcing. The demand for 'GM-free' products and a wider interest in products based on local value chains come together. There are intrinsic risks in selling products that have some sort of local, regional or national identity that in reality depend on long global supply lines, especially for soybeans from South America. Legume production in Europe can contribute to reducing those risks to the reputation of regionally-branded products.

Question 12: What is constraining the impact of the demand for 'local' food on the competitiveness of legume production in Europe?

Expert 1
Education. The demand for local in the UK is often related to place/short supply chains over product quality. There does not appear to be a real uptake by consumers of the idea that feed quality and origin matters as much as food quality and origin.

Expert 3
See previous comments … not an issue in Ireland (perhaps more in other countries)

Expert 6
I guess, it is the costs and the constraints for a certification which should allow for a supply from different regions due to the intrinsic risk for legume production by regional drought.

Expert 7
Labelling of products using non eu protein e.g. made with american soya or made with brazillian soya needs to be on products.
Consumers will not seek out eu protein unless they see what it is not in otherwise policy makers will have to step in and regulate on imported protein.

Expert 8
Raising more awareness in the consumers about the source of food and the source of ingredients in many of the products available.

A worry about the supply of locally produced food will not be able to meet the demand of the consumers.

The need to keep costs of food as low as possible for the consumers and locally produced food may appear more expensive as a result of a fixed price.

Expert 9

The sale prices. In a lot of cases, the increase in the production cost of a product produced, which wants or is required to have the above characteristics, is not absorbed by the selling price due to the intense competition.

Expert 10
Food safety is still an issue for local food. As I mentioned before, very small producers are not able to treat their products with the most appropriate ways, leading to door to door sales of bulk items. This strategy is not accepted in large cities and especially from young people who are not very familiar with unpacked food stuff. Larger productions would lead leguminous producers to create products that can be sold in local supermarkets

Expert 11
Higher prices of local food – yes it is a contradiction, but that is what I hear from producers. Even for legumes that could produced very easy under local conditions like pea, bean and lentil. It is cheaper to import from Canada or from China then to use the local produced legumes.

Expert 15
There is only a small market share driven by "responsible" consumers.

Expert 16
Most consumers of food from livestock would assume that food is 'local' if sources from local farms from animals consuming local grass. Use of complementary feedstuffs sourced from around the world, be that palm kernel expeller from Indonesia or soyabean meal from Brazil, is largely invisible.

Expert 17
There are no stable links and interactions between producers and processors.

Expert 20
It is not observed in Bulgaria.

Expert 22
Demand for regional products is not as high as surveys have shown.
There is little supply from supermarkets in their own region.

Expert 23
Despite fine words, many products that claim or use a regional identity come from value chains that use commodity trading of imported raw mateerials, esp. soy.

In the case of soy for animal feed, soy supply chains are regarded as stable and quality consistent – this combination of scale of supply, resilience of supply chains, and low cost is difficult for value cain leaders to reject in favour of local supplies.

Expert 24
More regional demand for livestock products could increase the competitiveness which is constraint by companies offering such products and consumers demanding them (paying more for them).

Expert 25
Local foods have higher prices targeting this information from third countries - China, Turkey, Ukraine and others.

Annex 5. Round 3: Synthesis of responses on constraints

Round 3 looks at the constraints that are relevant to the opportunities as identified in Round 1 and 2. In Round 3, open questions are asked for each of the 12 value chain themes identified. Each expert was requested to answer the open question about **constraints** for each of the 12 value chain themes. It was emphasised that we are seeking real insights, not just information. This document sets out a synthesis of the replies in Annex 4.

Policy

Farm policy

Policy makers are part of the value chain. There is clear consensus in the expert group that payments and requirements under the Common Agricultural Policy (Pillar 1 and Pillar 2) have a profound effect on farmers' decisions. Farm policy measures can incentivise the production of grain legume crops directly by providing direct payments coupled to the legume-cropped area (Voluntary Coupled Support, VCS), or stimulate them indirectly by incentivising particular approaches to cropping. They are voluntary because it is optional for member states to use them. Sixteen member states provide VCS to their farmers and payments vary at about 200-300 EUR/ha. In addition, some member states, notably in some federal German states, make payments to farmers who have particularly diverse cropping systems. In North Rhine-Westphalia for example, the AEM provides 90-125 EUR/ha to farmers who commit for at least 5 years to grow at least five main crops with each covering between at 10% and no more than 30% of the cropped area. The area of legume crops, including legumes in forage crop mixes must be at least 10%. On average experts see the VCS as particularly effective. A small number of experts from regions where whole-farm payments for diversification are used (1.2) give this intervention a high score.

Question 1: Voluntary coupled support is used in 16 member states. A few member states or regions use Pillar 2 whole-farm payments for legume-supported diverse cropping systems. What in your experience is constraining the wider adoption of these direct interventions in cropping decisions?

Policy: Reluctance to use instruments that could distort farmers' cropping decisions is a deep underlying factor in national policy communities. The 'decoupling' process can be traced back to reforms that were started nearly 30 years ago and there is an instinctive resistance to reintroducing coupled payments. They are also constrained by funding-mechanisms that limit their impact. Their dependence on national policy positions make them unstable in the eyes of long-term investors in value chains, for example plant breeders. This all constrains the support for them. In addition to the fundamental objection to market-distorting measures, experts report that some national policy communities do not see arable farming as a priority for public intervention. Arable crop production less system relevant than livestock production which is scaled to ensure post-farm processors (dairy and meat) are operating to their full capacity.

The coupled payments are favoured by conventional large-scale arable farmers where they are offered. They value the fact that the payment is not bound to any requirement other than to produce the crop. Several experts refer to the potentially greater

acceptance of payments that are focused on diversified cropping. The advantage of these is that the intervention is more closely linked to an agri-environmental outcome (more diverse cropping that includes legumes) than specific to production lines, although it can be regarded as an aid to specific legumes where circumstances point towards a specific legume species. This means farm-level payments more closely follows the principle 'public money for public goods'. There is good value for money considering that farm payments covering the whole arable area are only about a third of the basic farm payment. This ultimately raises the question of resistance at the World Trade Organisation level if these measures contributed to a significant reduction in imports of plant protein.

The reaction of farmers themselves is also mentioned. The farm lobby's reluctance to accept payments linked to public goods instead of the now traditional area payment is a conbstraint. The switch from direct area-based farm payment to payment linked to environmental measures and practices is accepted reluctantly. Furthermore, the acceptance of of some measures such as payments for diversification are strongly influenced by experience with them. Both these payment systems are adopted in only parts of the EC. This is especially so for diversification.

Depression of market prices: Coupled payments are reported to depress the local market price for the produce. Some reports suggest that this is a genuine depression in prices in local markets due to increased supply at harvest. Others suggest that traders at least partly integrate the coupled support of production into the price they offer growers. This reflects markets that are not functioning properly and offering the real market price. This is reported for Romania for example. The role of a competitive post-farm post-farm trading and processing sector that reflect real market values is emphasised.

Cost: Several experts refer to the cost of these measures. Broadly-speaking, the coupled payments are about the same as the decoupled area payments but their overall scale is limited by a cap on the total amount paid. Currently, Pillar II diversification payments impact on member state and regional budgets which is a disincentive for poor regions in particular.

Administration: Some experts mention the increased administration burden as a constraint. This concern varies from region to region but there is a general plea for simplcity and trust. Secondly, the system must be simple and adaptable to weather, markets and local conditions. Schemes will be widely adapted by farmers if applying for a subsidy is a tick box exercise with easy to follow flexible rules. Complicated systems with too many controls constrain acceptance. Regulators must see the big picture and accept that not every cent can be spent perfectly. What matters is the impact on the majority, not excessive regulation to control a< minority that affects everyone.

Environmental policy

Environmental policy is use of laws, regulations and public incentives to address the impacts of our activities on the environment. The EC's Farm to Fork Strategy is a breakthrough because of its integration of agricultural, environmental (esp. climate), food, and health policy in the EU. These include the emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about the merits of dietary change. Two areas of policy are particularly relevant: nutrient use (Nitrates Directive, regulation of fertiliser use), and biodiversity. The nitrogen and phosphorus cycles have been the subject of EU and national policy since the introduction of Nitrates Directive in the early 1990s. Moving forward, nitrogen and phosphorus accounting or balances are increasingly considered. Mandatory use of lower than optimum nitrogen application rates is now widely discussed.

Question 2: All farms in the EU are subject to some incentives and regulations that impact on nutrient use and biodiversity. What is constraining the impact of these measures on the production of legumes in your country or region?

Nutrients: The main target of nutrient regulation is nitrate in water where legumes are not directly relevant. There are suggestions that the current focus of the Nitrates Directive on organic nitrogen is not helpful. Nutrient regulation might better support nitrogen fixing crops if regulators would address the farmgate N-balance (nitrogen fertilizer and purchased feed nitrogen input minus nitrogen export by the agricultural products), As it is, regulation does not explicitly recognise the effects of biological nitrogen fixation in the reduced risk of leaching from the legume crop and the reduced nitrous oxide emissions. The use of legumes is not promoted sufficiently by industry in general and agronomists at the farm level as a viable alternative to the reduction of fertiliser nutrient use, especially N. More information is needed for the potential growers of these crops to provide confidence in the successful yields and the advantages of fixed N for the next crop in rotation. A focus on reducing the nitrogen surplus (farm-gate balance) could be an incentive at least outside regions that have a high livestock density. Even though legumes have benefits for the nitrogen cycle, regulations tend to act as a disincentive to their adoption. Regulations that focus on the fertilisation of each individual crop are regarded as a disincentive for legumes. The regulation might assume a nitrogen carry-over from the preceding crop that is greater than it actually is.

Biodiversity: The lack of evidence that legume crops themselves have benefits for biodiversity is a major constraint. The idea of adjusting cropping systems for biodiversity benefits is largely unknown at farm level. The benefits for farmers of biodiversity schemes that use legumes are often greatly reduced by restrictions on pesticide use.

General: Policy is focused on single problems with a narrow approach e.g. nitrate leaching and does not address it with a systematic approach including other issues where legumes could come in. In the UK, there is some expectation that agricultural policy will become more integrated after Brexit resulting in more favourable conditions for legumes. There is a general tendency in the farm organisations to reject regulation and claim that there is no economic alternative to the farming or cropping systems that are currently dominant. The negative reaction of farmer groups to proposals to limit nitrogen fertiliser use on grassland is a good example. A system adjustment with clover can compensate for reductions and support a good economic outcome for farmers. Farm lobby groups

instinctively lobby against change because all change risks bringing losers as well as winners. Maintaining the status quo for the interests of the pre- and post-farm sector is also a big driver of this conservatism.

Market policy

By market policy we mean interventions in value chains to support specific market-related outcomes. We have identified two types of market intervention: regulations on minimum levels for the inclusion of European-grown grain legumes in animal feed, and public support (e.g., advertising campaigns, certification of origin, labels) for efforts to raise public awareness of supply chains and products that use European-grown legumes.

Question 3: Based on your knowledge of policy-making in your country or region, what is constraining intervention in markets for legumes?

The economic case for boosting European protein production is weak as long as we have relatively low-cost protein from South America. This benefit of exploiting comparative advantage dominates market policy thinking. This flows into the dominance of commodity trading for feed ingredients in the main livestock sectors. Even sectors that foster a green image such as for dairy products are committed to purchasing the inputs at the lowest cost. One expert reported that those in the trade and livestock production "know the price of everything but the value of nothing". The agribusiness community is not only dedicated to commodity trading in plant protein, it is also discouraging system change that might result in reduced markets for farm inputs e.g., fertilisers and feed. Increasing legume use reduces these markets and might even support on-farm feed production. Agri-business resists this and has the political connections to influence policy accordingly.

The consumer is largely unaware of how feed is produced and used and ultimately how livestock products arrive on the shop shelf.

The feed industry lacks a concern with origin. If the origin of feed was a factor in the declaration of the origin of the product, the market for feed ingredients would be very different. This would sharpen the whole feed industry if it was implemented. The feeding stage is at the start of value chains which is not visible to consumers so that even high value certified products such as Parma ham are not required to be based n local protein supplies.

A direct public policy intervention in markets is practically impossible due to WTO rules.
Policy makers are informed well enough but lack a framework to intervene.
The feed industry is focused on maximising its efficiency within the current framework.
The environmental benefits of more sustainable protein sourcing is not acknowledged. It can change if given time to do so. Only if they are aware of a profitable market niche, will they move away from commodity trading and if they are optimistic for further gain (in image), they might even go a little bit further (in order to proof that they really are looking for alternatives to rain-forest devastating soya from Brazil) and eventually be less opposed to slight moderations of their traditional attitude.
There are no constraints in principle on public support for softer marketing measures such as labelling of origin. Hard identity protection (hard IP) is constrained by the

bureaucracy involved but this can be overcome by schemes that reward production without identity preservation. A major constraint is that most legume crop produce is a farm input (feed). Protein is a hidden input.

Primary production – farmers

This looks at the opportunities that would be acted on specifically by farmers. These are categorised as conversion to organic farming; market opportunities that drive agricultural system change; technological opportunities that drive agricultural system change, changing farming systems, and changing cropping systems.

Conversion to organic farming
The demand for organic produce is growing. Growth in organic production is particularly relevant because legumes are almost the only managed source of reactive nitrogen in organic farming systems. Here we are interested in the wider impact of organic farming on conventional farming. We are concerned with the impact of the growth of organic production on wider legume production and use in conventional farming.

Question 4: Based on your knowledge of farming systems in your country or region, what constrains the impact of the development of organic farming on conventional farming?

Several experts challenged the idea that the development of organic impacts on conventional agriculture at all. Also, the organic sector is still a slow-growing niche in many countries. It impact is very limited in eastern Europe for example. Organic farm businesses are focused on that niche and don't impact outside it. Organic farming is not considered to have anything special to convey to conventional farming in the area of legume production and use. The attitude is that organic farming is not sustainable and for a fringe market. Lessons learnt from organic producers are not translated to the conventional farmer in a way that promotes both the yields and the environemtal benefits and they are view with suspicion.

However, some experts draw attention to a history of transfer of practices from organic to conventional agriculture. Some practices that in the past were considered the preserve of organic are now available to conventional farmers who may be particularly interested in carbon sequestration in soil or improving biodiversity.

Agricultural systems change

An agricultural system is the organisation between farms and other businesses over a geographic region which is characterised by common soil, climate or other circumstances. Experts identified four areas of opportunity to develop legumes at the agricultural systems level. Their constraints are addressed in turn.

Opportunity 5.1 is about the increasing interest in traceable and sustainable protein sourcing, especially protein sources that disconnect value chains from land-use change in South America.

Question 5.1: Based on your knowledge of value chains in your country or region, what constrains how sustainable, 'deforestation free' protein sourcing impacts on the development of European-grown legumes?

The dominance of commodity trading: price is a major constraint. The sectors that use soya from South America are very conservative characterised by commodity trading both for inputs (feed) and outputs (carcase meat, milk and eggs). Even industry players who are well-placed to benefit from a market for 'deforestation-free' products (e.g., the Irish dairy sector) are reluctant to raise awareness. It opens a Pandora's box about how animals are fed. Furthermore, market efforts to improve process quality are focused on animal welfare: where feed comes from is down the list of priorities. This is constrained by the promotion of locally sourced produce that would attract the sustainable label. There is currently not the potential to utilise the level of production as it is still at a low level. The value chains need to be developed from a small and relatively expensive niche market to be incorporated by the larger suppliers.

While awareness of consumers is growing, it is still low and not impacting on markets for feed ingredients. Establishing a link between consumers' decisions and how livestock feed is sourced is difficult. The success of organic shows us that we need labels that summarize many system changes in one. In all this, retailers and food processors (e.g., dairy processors) are key to an effort to reduce the dependence on imported soya.

There is a need for options, of which there are three:
Sourcing of American soy certified 'deforestation free'
Sourcing of alternative protein sources like meal from sunflower, rapeseed or European-grown legumes.
Complying to 'deforestation free' by exclusion of soybeans ('soybean free')

These need to be mixed and integrated.
There are imported 'deforestation-free' options. A switch to 'deforestation-free' can be made without changing the agri-food system much. There is also the question of the definition of 'deforestation free'. In the event of a strong market for deforestation-free protein, these other imported options would be in a strong position to meet demand. These include soy from North America and rapeseed meal from Canada. Also, European soy is not yet well known.

The need to build value chains based on European legumes using positive messages about European farming was emphasised. Pointing the finger at over-seas production systems is not always helpful. The case for change in Europe should be built on a drive to improve European cropping practices, especially through better rotations, not on excluding imports.

Consumers do not demand regional protein for the products sufficiently (despite studies showing the opposite e.g., Profeta & Hamm 2019 Do consumers prefer local animal products produced with local feed? Results from a Discrete-Choice experiment).
Lack of a European label for products based on European feed resources. It could be 'From European and deforestation-free feed'.

Opportunity 5.2 is about the increased use of contracts rather than commodity trading. Contracts allow a price to be fixed that the contract parties agree is a fair and allows production to be sustained into the future.

Question 5.2: Based on your knowledge of value chains in your country or region, what constrains the development of crop trading using fixed-price contracts for tracable and certified production?

Practice in some industries shows that fixed price trading can be significant, for example in the whisky industry, and for crops for processing to food products. Other food products are legume-based 'vegan' alternatives to meat and dairy products. The development of fix-priced contracting is constrained by the advantages of commodity trading in large-scale markets. Contracts work for food products. In practice, development is constrained by the lack of premia for produce. Prices are fixed in advance and contracts can be undermined by higher than expected spot-market prices at harvest. This confines them to niche markets. Yield instability in legumes also constrains contracting. Some experts predict that the use of contracts will increase if the processors (mills) are forced by the market to set up these contracts if the demand for origin-defined feeds increased. Product labelling is regarded as a key tool. Contracts will develop if the market wants 'native' protein. Fixed priced contracts are also constrained by the time and effort that goes into establishing them. Buyers can only offer the price that the market for the final product can support. There is a level of fixed price contracts for both milk and arable products but these are based on a amount of supply and a quality basis. There would need to be a more recognised or qualified certification process to be able to promote products to the larger suppliers. However, there is a movement towards this in the milk suppliers and their influence on the farmers to use less soya in the cattle feed etc.

The biggest limitation is the lack of quantities from an entity (farmer or cooperative) capable of meeting the annual needs of a user, for example dairy farms. Moreover, there is no culture of cooperation through contracting, which often makes both parties vulnerable in case of someone does not comply with the spoken agreement.

The largest constraint is the inability of producers to cooperate and gather their production into large amounts, assuring for appropriate quantities for local or national markets. That is the reason why commodity-trading middlemen play a vital role, gathering the production and gaining the extra value of the whole procedure. Fortunately, local climate permits organic farming without many loses for the producers in the field. Aligning with EU and market rules is the key element for its promotion.

Some contract arrangements bind the farmer into purchasing the inputs from the contract partner – this constrains farmer acceptance.

Opportunity 5.3. Pig and poultry production is moving to eastern Europe. This results in better linking of European livestock production to Europe's crop resource base, better nutrient cycling, and employment opportunities in rural areas (as an alternative to emigration to do the same type of work in western Europe). For legumes, there are two effects: the reduction in nutrient surpluses in western Europe increases the acceptance of legumes in those areas and the increased market for plant protein in eastern Europe may stimulate production for local use there (rather than for grain export).

Constraint 5.3: Based on your knowledge of agricultural system change in your country or region, what constrains the impact of structural change in pig and poultry production on the development of legumes?

The pig and poultry sector require large volumes of uniform quality. These livestock sectors are concentrated and this is not likely to change. Their requirements often far exceed local production of grain legumes. The current structure of the pig industry, concentrated in north-west Europe, is at least partly due to the easy access to North Sea ports (Rotterdam, Brake etc.). Change to European protein sources is constrained by the advantage of this import-oriented infrastructure. However this business model is under pressure due to nutrient excesses, especially with the tightening of the implementation of the Nitrates Directive. Destocking in the west compensated by increasing livestock production in the east is an obvious way forward. It will reduce the nutrient excess and make legume production easier in those regions. The production in the east will be much better coupled to the land resource, including proximity to European soybean production. However there are two major constraints to turning such a change into an opportunity for European protein sources. The production that will transfer to the east will be standard commodity meat production based on commodity-traded feed. This includes the use of imported GM soya even if soya is grown locally to European standards (non-GM). Another constraint is the lack of clear policies to couple livestock production to the land base. Such changes would come along with high social and economic costs for the regions in western Europe, where production would decrease. Farmers in those regions have invested in livestock housing and other assets that lose their value if production is no longer profitable. For the same reason, there is huge resistance to structural change in the livestock processing sectors, especially in pig and poultry processing. Processing is concentrated in a few companies that have invested heavily in regions characterised by concentrated livestock production, for example north-west Germany. These companies must ensure that these factories operate to full capacity supplied by local farms, even if these farms are constrained by large nutrient excesses. This situation is strongly defended by local policy communities despite the social and environmental consequences. For a destocking of western meat producing regions to have an effect on legume production there, a significant reduction in the value of agricultural land assets is required. This land now commonly costs between 50,000 and 100,000 EUR/ha or 1,500 EUR/ha in annual rent. One driver is the high demand for land for disposing of slurry. These high values linked to the excess of nitrogen drive nitrogen-fixing crops out of the system. These farmers must grown carbohytrate rich crops that respond to and wirhstand high applications of slurry. That means growing as much maize as possible.

The incumbent producers and processors in the west are a strong lobby that resists change. Due to the regional occurrence of the African swine fever, the pig market has nearly collapsed, which has left many pig-producing companies in great economic difficulties.

Constraint 5.4: Based on your knowledge of value chains in your country or region, what constrains the impact of small-scale processing technology?

The impact of this technology beyond local niche markets is constrained by a chicken and egg problem. A larger impact requires more widespread use of this technology. Large scale use also requires experience with less intensive feeding systems.

There are deficiencies in quality control. A rapid testing method is required to allow continuous feed-back control of the processing. The output must consistently meet the highest standards for livestock feeding – an optimum balance between processing cost and throughput, nutritional value and control of anti-nutritional factors.

Even though the processing can be operated on-farm semi-automatically, the costs per unit output are intrinsically higher than industrialised processing. Consumers are unlikely to care about this step in the value chain. Only very local or organic markets are likely to support processing.

Small-scale processing of pea or fababean for ruminents is simple but there is low awareness of this option amongst farmers and there is a lack of access to the crop in the main dairy and beef producing regions. The relevant contractor-based infrastructure is not present. Support in capital investment is lacking.

Farming systems change
A farming system is the organisation of individual farms. Change to lower cost farming systems was mentioned in Round 1. This includes introducing cereal-legume bi-crops for on-farm feed, introducing forage legumes, and on-farm production of grain legumes. The common driver is the reduction of costs.

Opportunity 6.1 is about moving towards lower cost farming systems is a strong, long-term and real driver behind increased legume production.

Question 6.1: Based on your knowledge of farming in your country or region, what constrains how the development of lower cost farming systems that make greater use of legumes?

Traditional research conducted over typical 3–4 year timeframes do not provide the long-term systems assessments that are needed to look at the full economic effect of system change. Lower cost systems may be as profitable as high cost systems but risks are perceived to be greater. Farmers are focused on the traditional annual gross margin calculation and find it difficult to do more holistic assessments that integrate multi-annual effects and that also consider effects on overheads and fixed costs, for example the effect on costs of a more even distribution of workload at sowing and harvest.

The past yields and sustainability characteristics of some of the crops varieties have made farmers suspicious of these crops. New varieties need to be promoted more widely with demonstrations of the crops against the commonly grown crops.
Technologies that reduce costs are often easier to adopt in organic systems than in conventional, for example bi-cropping. The agricultural trade has a big influence on farm practice – they have little interest in reducing costs. The trade is focused on picking up experience of a new input and conveying it to to other farms in the context of sales. Farmer experience of cost-reducing techniques such as bi-cropping are not communicated by farmers.

Moving to a lower input cost system generally involves increased complexity. Managing complexity involves increases in other types of costs, especially management time. Convenience and simplicity are major attributes of the service offered by feed compounders and their value should not be underestimated. A compound feed can be a truly complete feed (for monogastrics) or a complete complement for forages (for ruminants). Introducing a protein-rich home-grown feedstuff such as beans means the farmer has to make other changes to livestock diets, requiring time and probably introducing further complexity. The avoidance of complexity is a major constraint in

moving towards lower cost systems that use legumes. Yield instability in grain legumes is a constraint to reliance on on-farm or local crops. On the other hand, the yield stability of lucerne in droughts favours uptake.

Farms in recent years have become highly specialised and focused on optimising relatively simple linear production systems. Farm businesses have lost an appreciation of the value of economic resilience that a lower cost base brings.

Cooperation between single farmers still remains a barrier. Even in the case of profitability, farmers choose to spend more money in order to be independent. They are afraid of sharing their equipment because they do not know what will happen in case of an accident or who will pay for the repair of a damaged machine. Furthermore, farmers have the ambition that "my way, is the best way", not allowing other people's knowledge to change their minds.

Opportunity 6.2. This is about the use of cereal-legume intercrops/bi-crops are a viable option, especially on mixed farms.

Question 6.2: Based on your knowledge of farming in your country or region, what constrains how the development of intercrops/bi-crops as viable way of introducing legumes for on-farm use on mixed farms?

There are significant technical and engineering constraints to adoption. This includes synchrony of maturity. It is difficult to generalise information on intercrop management. It is all about tailoring to local conditions – in part because one crop will always have a competitive advantage over another in a given pedo-climatic niche. So there is a need to understand the principles of intercropping and then apply them.
Lack of marketing opportunities, dependent on internal farm use.
Intercropping was very common in the past e.g. pea-oat and is not used in conventional and hardly in organic farms. Separation is an issue, i) not possible to sell when still mixed, ii) separation is expansive, iii) when used for own feed quality varies and requires additional sampling and efforts. In conventional farming fertilization/pest/diseases management is difficult/ impossible (products are not registered for mixtures, they harm one of the component etc.). Research seems to overestimate the potential. We work now on soy/wheat IC and strip cropping to overcome the negative side of the mixing.
Often bi crops have poor weed control options so must be drilled in a narrow window and cut in a narrow window to maximise feed quality. They also need good info around pitting and storage and need infrastructure.
Simple solutions like bi crops are generally lower yielding and then the famers have one bad experience and it wipes all the gain from the previous 3-5 years average gains. So then they say it is easier to buy imported soya and keep life simple.

Opportunity 6.3. This is about the effect of economic viability of legume production on mixed farms.

Question 6.3: Based on your knowledge of farming in your country or region, what constrains the increased production of legumes on mixed farms?

Harvest risks on mixed farms in wetter regions where mixed farming is more common. These risks are increased where dessicants are not used. The arable area of mixed farms is valuable for other crops such as cereals which might be a greater priority for home-feeding.

For grass, high N use and weed control tends to decrease clover persistence ... couple this with low pasture reseeding rates nationally and an unwillingness (often unsuccessful) to over-sow clover into existing swards ... all reduce the increase use of legumes on mixed farms. Mixed farms are already relatively complex and so introducing legumes adds to that complexity.
There are several very effective technologies for growing and using cereal crops on farms that have livestock, for example crimped ensiled wheat grain. This provides a good foundation for low-cost rations including food co-products, urea etc. In these circumstances farmers would opt for a purchased protein supplement. Adoption of legumes on mixed farms tends to be a consequence of market rules – for example for livestock product certification that requires own feed or organic.
Mixed farms by definition have a source of organic nitrogen in livestock manure. This reduces the incentive to grow nitrogen fixing crops.
Lucerne fits in well to mixed farms but the technology is often not available.
The high competitiveness of cereals on mixed farms (against grain legumes), especially if forage crops or short-term grass lays are in the arable rotation.

Concerns about the potential sales of the crops to the markets as they haven't been expanded as commercially as possible.

The worries of the additional costs of growing legumes in current rotations and any additional machinary costs.

The ease of using standard soybean meal as a protein supplement on farms where grain is processed for feeding. Resistance of the compound feed industry to on-farm feeding. Mixed-farm businesses often find it more convenient to sell crops 'off-the-combine' than to store and process them to animal feed for their own use. It would help to examine the technology options and costs of on-farm processing in an integrated way – cereals and legumes.

The production intensity of livestock enterprises is too high. There is a strong focus on physical performance at the level of animals, sometimes even individual animals. Livestock are now fed to get the last % of production at the animal level without a corresponding understanding of the economic responses at the whole farm level.

The use of forage legumes on mixed farms is generally regarded as more viable than grain legumes. The lack of local feed milling options for small quantities of legumes is a constraint.

Cropping systems change
This is about change at the level of individual crops or groups of crops. Change here is ultimately about raising the on-farm performance of legume crops compared with other cropping options. This can happen by improving the performance of legumes themselves or through the decline in the performance of other crops, due for example to rotational problems. Experts also highlighted crop species in themselves as opportunities. These

include lucerne and red clover as forage species that fit into arable rotations. Whole crops of faba bean, pea and cereals are also mentioned. Three sets of opportunities were identified: increasing the relative competitiveness of legumes; adoption of technology; and plant breeding.

Opportunity 7.1. Legumes compete for land with other crop options in cropping systems dominated mostly by cereal species. They also compete with major oilseed crops such as oilseed rape and sunflower.

Question 7.1: Based on your knowledge of cropping systems, what constrains the improvement of the relative competitiveness of legumes within cropping systems?

The competitiveness of grain legumes greatly depends on whether other spring-sown crops are already grown. If the key competitor is a spring cereal, legumes can compete. They struggle in classicial winter cropping systems. Faba bean is more suceptible to drought, even compared with spring barley.

Where the crop must be sold, the feed industry under-estimates feed value and does not fully reward the nutritional value. The prices are too low compared with other crops. Integrating legumes into rotations is not always easy due to the need for 6-10 year breaks between legume crops.

The price of imported soybean is the the economic benchmark that all changes depend on. Other factors such as "regional", "more sustainable" are only relevant, if they become a part of consumer preferences or if they are shaped into legal instruments. If gross margins of European legumes stay lower than those of other crops, their share in Europe will stay low. Benefits for crop rotations might change this perception, but this will take time.

The lack of progress in the genetic improvement of crops is seen as a constraint.

There is a lack of understanding of the real economic performance of crops. The real costs of high-input crops is not fully appreciated, especially the external costs. Use of legumes in rotations depends on the success of intensive cropping systems for cereals and oilseed crops. Disease, restrictions on plant protection products used on cereals and oilseed crops, and increasing problems with grassweeds in cereals could create opportunities for legumes.

Certification and labelling schemes are needed to gain recognition in consumer markets.
Markets are not secure. The markets for crops that are exported and traded internationally are more secure than local markets for local legumes.
There is still a lack of disease-resistant cultivars of yellow and white lupin.
Regionally suitable grain legumes such as soybean and pea lack drought-tolerant and thus more yield-stable cultivars.

Reliance on spring-sowing is a constraint. From a crop-physiological viewpoint, the spring-sown cropping characteristic is a constraint, for both yield and yield stability, in the competition with other cropping options. Winter wheat, barley and oilseed rape are extraordinarily well-adapted to most European agri-environments. Even where spring sown arable cropping is common (spring barley in Ireland, sunflower in south-eastern

Europe), there are very good reasons for farmers to continue using those other spring-sown crops instead of spring-sown grain legumes. In particular, hybrid sunflower is extraordinarly well-adapted to south-eastern Europe. Part of this is due to the much greater investment in plant breeding linked to the hybrid character which gives breeders a good return on their investments.

The potential biodiversity benefits of retained autumn stubbles over winter that spring-sowning makes possible are not fully understood and recognised. Similarly, the effects of spring sowing on solving weed problems in autumn-sown crops is not fully appreciated. Ultimately, cropping systems at being driven to resource and environmental limits. How to bring systems back into a safer more sustainable operating space is not fully understood or appreciated at farm level.

Legumes are generally minor crops. Especially in the east, the market for major crops that are exported is more secure than local markets for locally grown legumes. There is a market for wheat, corn and sunflower for export from eastern Europe.

The methods of successful growing of these species, especially lucerne in more marginal areas. The best types of soils and the herbicides that can be used to ensure establishment of the crops along with harvesting methods to make certain the maximum yield and protein is harvested and ensiled.

The position of the legume crop in the rotation is important therefore more practical knowledge of the benefits for these crops in fixing nutrients, improving soil structure and overal soil quality.

Opportunity 7.2. The performance of the currently available legume crop cultivars can be increased by better seed trading, treatment of seed with inoculants, and adoption of cultivation techniques. Legumes compete for land with other crop options in cropping systems dominated mostly by cereal species. They also compete with major oilseed crops such as oilseed rape and sunflower.

Question 7.2: Based on your knowledge crop production, what constrains the adoption of existing technology to improve the competitiveness of legume crops within cropping and farming systems?

The question of inoculants for ‘native’ legumes comes up frequently. There is a lack of clear evidence about and access to such inoculants. Success depends fine-tuning on all relevant steps of cultivation: selecting an appropriate field and cultivar for the aimed use, verifying sufficient germination rate, inoculating a reliable product (soy and lupin), seeding at the right moment in a properly prepared soil, efficient weed regulation, supervision in case of upcoming problems, harvesting at the right moment, ideally with a flexible cutting bar (soy). At the strategic level the access to technology is constrained by the low returns to investment in these crops compared with the major crops, especially the major hybrid crops such as maize. Even if there was a big investment in technology, it is very difficult to improve yield stability. Most extension services are not interested in farming system change. There are no particular constraints on the adoption of existing technologies currently available to farmers and value chain businesses. These crops use

conventional existing farm machinery and knowledge of how to produce them is freely available. Experience shows that farmers who want to adopt new crops and technologies readily do so if the crops are available.

If legumes are grown, then most of the available technologies are usually used (recommended varieties, inoculation when needed). There is still a research gap about what technologies are really the best and can increase yields (weeding, micro nutrients, direct seeding).

Although Greece had a relative good relation with leguminous crop production and their consumption, especially after the end of WWII, gradually this relation fade out due to the fact that other cultivations were offering a greater amount of income. That is the reason why most producers cultivated cotton, corn or tobacco. After the economic recession of 2008, many farmers turned to leguminous crops because its cultivation is not input-intensive thus production costs are significant lower. However, it should be underlined that certified seeding material should be developed in a greater extend in order to cover producer's needs. Although national agricultural centres have made efforts for producing new cultivars, a greater promotion is needed. The competitiveness of legumes would be improved by more higher yielding cultivars and those that are more sustainable with a pasture sward for forage. There is a view that red clovers in a mixed sward are out competed after only a few years and the benefits are lost, or in as a sinle species sward their productivity decreases after only 4 years.

More information the production of mixed cropping sprecies i.e. pea and barley and the methods for successful cultivation especially as a whole crop for forage. The timing of sowing and harvesting etc.

Is the limitation of producers to align with production protocols.

It is very difficult to persuade dairy farm owners to make changes in their ratios in fear of changes on the quality characteristics of the produced milk

Generally real-case experiments are the greatest way to persuade both sides that this small value chain can be profitable or all stakeholders involved.

Opportunity 7.3. The future competitiveness legume crops can be increased through the genetic improvement of species – plant breeding. This starts with using crop physiology to frame target traits (especially for yield), breeding for food quality traits; breeding for feed traits.

Question 7.3: Based on your knowledge crop production, what constrains the explotation of potential of plant breeding? Please mention where relevant constraints on specific opportunities as well as the constraints on plant breeding in general.

The underlying constraint is the lack of returns on investment in the improvement of these minor in-bred crops. The market for seed is small and the flow of royalty income is not secure. This results in a fundamental market failure with under-investment in breeding, especially in pre-competitive pre-breeding activities. Soy is partly an exception

to this in that European breeders can use breeding material from the global soy effort. But even this does not match the effort invested in maize and other cereals.

The pre-breeding effort is fragmented. Pre-competitive pre-breeding is hardly organised in any way. This means that the connections between public academic research in relevant genetics and the genetic improvement of the crop are weak. Academic research is organised by disciplines that relate to genetic technologies while breeding is crop-species specific. Many large research projects do not efficiently articulate generic academic questions into species specific breeding.

Some public plant breeding activities in eastern Europe are still conditioned by the belief that environment/region-specific breeding programmes are needed. It is argued that the parent maintenance and selection effort, the crossing, the establishment of lines and finaly the selection of lines as new cultivars must take place in the environment in which the cultivars will be grown. This 'one agri-region – one breeding programme' concept is inefficient. A more systematic international approach is required that separates crossing from selection for different environments. This means relatively centralised generation of variability (crossing) combined with local selection from breeders' advanced lines. Feedback from local selection to the centralised parent selection and cross is needed to improve the match to environments. This needs more communication with the farmers who would potentially grow the varities to ensure they have confidence in the crops yield and sustainability (if part of a forage mix).

The breeding challenge is complex with the need improve several complex traits together: yield, quality, and disease resistance. Gene editing will help. Rejection of gene editing harms progress. Plant breeding is a long process (over serveral years) and so the breeders need to be sure of the traits that are important to sell the seed after that period are valid.

Breeding needs to give more attention to traits that will allow production in a wider geographical range, especially cold tolerance and winter hardiness. More attention needs to be given to quality traits. These can be a game-change in local markets. This includes attention to the amino-acid profile.
The lack of good functioning local selection by an active seed trade is a constraint in some countries.

Processing and manufacturing

Opportunities from improved quality assessment

The assessment of grain quality does not usually recognise important quality differences, especially for food and higher-grade feed uses. Serving and benefiting from more demanding markets depends on more precise quality assessment. More precise quality assessments enables markets to recognise and reward production that better meets the needs of high value food and feed markets. Examples include legumes with precisely measured low levels of anti-nutritional factors used in fish feed and legumes that better meet the needs of manufacturers of novel plant protein-based foods.

Opportunity 8. The economic viability of legume cropping can be increased by using more precise quality assessment to recognise and reward the higher quality that better meets the special needs of high value markets.

Question 8: Based on your knowledge crop production, what constrains the adoption of more precise quality management within legume-based value chains to generate premia over commodity prices for high-quality production.

More accurate assessment of the nutritional components of beans and other forage legumes is needed but this also needs to be translated into action by the industry and ultimately the farmer. A drive towards more precise quality management leads also to smaller markets and quantities. Precision management of quality along thre supply chain requires investment in quality assessment equipment.

On soy, the problem is that special properties for use as food (taste, mouth-feeling/structure of the food product) are difficult to measure by chemical/physical analysis. The crop needs to be tested in the food production with a decision made at the level of the cultivar. For high-quality production therefore contracting the chosen cultivar with farmers is the solution. Also in feed production it might be advantageous to select a range of cultivar that meet the quality you are looking for in order to get a more homogenous stock that does not need a separation in lots of different quality (e.g. protein concentration).

There is a lack of connection between the feed industry and higher value end-users. The understanding of precise quality is not adequate. For example, there is a lot of information in the literature on antinutritional ingredients and there is also constant talk of antinutritional ingredients in agricultural extension, but there is no precise information on which antinutritional ingredients are still acceptable and in what quantities. These ingredients do not play a role for peas and field beans. Knowledge about the ingredients is still too imprecise. This lack of precision also applies to the quality properties of starches and proteins in legumes. But fortunately there are now some research projects on this.

These end users are specialised in their markets and are accustomed to getting the raw material they need from standardised soya products. The evaluation of the quality of the grain is performed by the processors. Quality above certain standards, is not rewarded in the price. There is a lack of reward in the pricing for producers.

The availability of the necessary quality testing techniques at the level of trading. Also, there is generally a poor understanding of quality common to growers and users.
Not a very important constraint in the moment except maybe for lupin and their alkaloids, this is really problematic and not yet understood (effect of genotype, environment, management). The lack of marketing of higher quality products and the explanation of the advantages, especially if they are more expensive. Lack of information on why higher quality is better for the consumer or a company that uses the products as an ingredient.

Improved methods of quickly establishing the quality of a product using a recognised certified method.

Brand protection and corporate social responsibility (CSR)

This is about efforts firms make to meet societal expectations concerning the social and environmental performance of products. In this context, this ranges from avoiding brand-damaging scandals through to product differentiation using environmental and social performance claims.

Opportunity 9. There is consensus between experts that brand protection and corporate social responsibility will support legume production in Europe. These range from brand enhancement and protection, exploiting increased consumer interest in sustainable protein sourcing in Europe, and consumer demands for lower carbon footprints. These can be grouped together under the term 'sustainable consumption'.

Question 9: What constrains the development and exploitation of markets that serve sustainable consumption that supports European legume production?

A lot of work is needed to raise the understanding in the general population about the cost of sustainable food. Also a lot of work to align local production standards with trade deals and the willingness to accept imports which are grown using technologies banned in Europe. Reduce the imported GM products (and very unsustainabily grown soya/maize) would improve the competitive edge and consumption of EU grown proteins.

The demanding challenge for smaller companies to make up a proofed CO2-footprint balance of its products.

The demanding challenge to organise the supply with beans every year by contracts with farmers – which have to be located in different regions due to the risk of insufficient yield caused by drought.

Policy makers are afraid of being too influential in the market.
End users are not encouraged to change because the purchasing trends of consumers is based on price not sustainability.

Huge farms can profitably grow starch and protein that is used in every food we eat. It is produced the same way on all the continents and trade is so well established, it is easy to correct shortages in one area with surplus from another area. Corn flour, corn syrup, soya oil, soya meal, maize distillers grains, corn gluten are the same the world over. Gm varieties use the same herbicide all over the world. The ony thing that changes across the world is the ripening date to suit the climate.

So it will be a huge change to trade to use faba beans or lentills or peas or chickpeas to replace corn or soya. We can only grow faba beans in Ireland so a surplus of chickpeas in Spain is no good to us as we have not processed them. And if we do process them and like them, we can't grow them. So surplus deficit trade will have more friction.

The real value of sustainability has not been yet clarified in the public. It seems more like an extra financial burden with no immediate impact.
Cheap meat production is an constraint to sustainable consumption the use of homegrown legumes increases the cost of producing meat meat substitutes based on

legumes are relatively expensive Limited attention by consumers. Too many ways to act sustainable.

Soya supply chains (direct to food and indirect via animal feed) are largely invisible to the final consumer – therefore he/she sees little value in developing alternatives. It is neccessary to look for ways to connect with the consummers different than advertising. The encumbency of commodity based value chains is the major constraint. Even leaders of value chains that could benefit are sometimes reluctant to 'rock the commodity boat'.

Lack of a label or brand that links the sourcing of plant protein in Europe to sustainable value chains in the eyes of the consumer.

Premia from 'sustainable' branded products are not passed back efficiently to farmers. For our country - its general backwardness. However, in economic terms it is in last place in the European Union.

A feeling that local markets are more important i.e. individual countries or regions than Europe as a whole. Brand protection again needs to operate at a regional level.
As it was mentioned before, there is a shortage of large amounts in leguminous crops.

Opportunities from processing technology

Opportunity 10. Several experts draw attention to the scope for using new processing technology and related product lines to increase the consumption of legumes in food. This can be supported by plant breeding for relevant quality traits. On the feed side, a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba beans in particular.

Question 10: From your knowledge of legume-supported value chains, what constrains innovations in processing technology that increase the on-farm competitiveness of legume crops?

Investing in processing technology is constrained by the chicken and egg problem. Investment dedicated to specific legumes is very risky. The market share is still too small to invest. The ProLupin example shows that developed an advanced processing technology (for food products) has little impact on the on-farm legume competitiveness. We need more research on the effects of processing on the nutritional value of pea and faba bean. We also need rapid testing for quality control.

Currently there is not trust for home grown legume production supply chain for food production as it does not exist. It is uncertain that additional costs/investments be rewarded by new market opportunities.

Consumers

Opportunities from consumption change

Opportunity 11. Several experts reported that the mega-trend towards reduced livestock product consumption will further increase the demand for protein-rich food products made from grain legumes. This opportunity is affected by regulation on food processing intensity in the organic sector which limits processing options for legumes in meat and dairy analogue products. Such a mega-trend may also reduce the concentration of intense livestock production in some regions (e.g., northwest Europe) reducing nutrient excesses in these regions. A dietary shift to greater use of plant-based protein-rich foods will reduce the demand for animal feed and thus reduce the overall demand for protein-rich crops.

Question 11: What is constraining the impact of consumption change on the competitiveness of legume production in Europe?

The extent of consumption change so far has not impacted on the legume production. Also, the trend might not last. The trend to less animal protein is happening to what extent this will translate to a large reduction in consumption is less clear. The trend needs more momentum to make an impact. Markets still favour the production and consumption of cheap livestock products. Markets are not aligned to sustainable consumption patterns. If it does, the total demand for plant protein declines. Arguably the increased understanding of diets appropriate for advancing age may supersede some of these trends (more protein as we get older).

The traditional uses of pulses for food are forgotten. An increase in legume use for highly processed alternatives to meat and dairy comes with disadvantages. Consumers will become critical that these are highly processed foods. Food companies generally opt for commodity trading even for high quality legumes – they generally don't any of the added value back to the farmer if they can avoid it. They are not willing enough to invest in integrated value chains. Taifun-Tofu is an exception to this.

We have good examples of the low income, higly populated countries that follow more environmentally and nutritionally balanced food production and diet like India and Egypt where the basis of the diet is on legumes and other vegetables and grains. The "Planetary Health Diet" by the EAT-Lancet Commission should be used strongly to promote the awareness of need for the change in agricultural policy. Few consumers really understand how protein-based value chains work and this awareness raising should not be solely the respoonsibility of NGOs.

Lower meat production in general will lead to less legume production (less demand for feed). Therefore, only a combined shift (less meat with a higher awareness for regional production) will increase competitiveness. The import of legumes could be reduced, while the production of legumes increases. For the typical consumer, a moderation/reduction in the consumption of livestock does not require switching to high-tech meat and dairy analogue products.

There has been a large growth in interest in non-meat based protein products and this has affected attitudes in the farming community, especially with livestock farmers. However, opportunities are being considered by more forward-thinking farmers on how this can be exploited with marketing of more 'responsible' products and promoting the reduced carbon footprint of the products.

Mediterranean diet (MD) highlights the role of legumes as a meat substitute. There is an old quote that "Beans are the meat of the poor", signifying their importance in someone's diet. Although, citizens in large cities like Athens and Thessaloniki are more influenced from a Western type of diet with larger amounts of meat consumption, I believe that the rest population in the countryside, still respects the basic guidelines of MD. However, leguminous crops can be further consumed especially by showing to young people how to work with them in a more up-to-date way. For example, new recipes that are matching more with modern tastes would be ideal.

Opportunities from the demand for local food

Opportunity 12. Experts raised a wide range of opportunities arising generally from consumer interest in local food. By 'local' food we mean food that is marketed on the basis of any differentiation related to origin, including the distinction between European and global sourcing. The demand for 'GM-free' products and a wider interest in products based on local value chains come together. There are intrinsic risks in selling products that have some sort of local, regional or national identity that in reality depend on long global supply lines, especially for soybeans from South America. Legume production in Europe can contribute to reducing those risks to the reputation of regionally-branded products.

Question 12: What is constraining the impact of the demand for 'local' food on the competitiveness of legume production in Europe?

Consumer interest in local food does not extend to feed. The risks to supplies of local protein-rich feed ingredients reduces interest on the part of feed producers. Consumers are not aware of where feed comes from and labelling on products based on imported feed is required. Even for pea and lentil for food, imports from for example Canada compete with European production.

Despite fine words, many products that claim or use a regional identity come from value chains that use commodity trading of imported raw materials, esp. soy.

In the case of soy for animal feed, soy supply chains are regarded as stable and quality consistent – this combination of scale of supply, resilience of supply chains, and low cost is difficult for value chain managers to reject in favour of local supplies.

More regional demand for livestock products could increase the competitiveness which is constraint by companies offering such products and consumers demanding them (paying more for them).

Raising more awareness in the consumers about the source of food and the source of ingredients in many of the products available.

A worry about the supply of locally produced food will not be able to meet the demand of the consumers.

The need to keep costs of food as low as possible for the consumers and locally produced food may appear more expensive as a result of a fixed price.

Food safety is still an issue for local food. Very small producers are not able to treat their products with the most appropriate ways, leading to door to door sales of bulk items. This strategy is not accepted in large cities and especially from young people who are not very familiar with unpacked food stuff. Larger productions would lead leguminous producers to create products that can be sold in local supermarkets

Annex 6. Round 4: Scoring of propositions on constraints

The purpose of Round 4 is to assess the degree of consensus in the group about the constraints identified in Round 3. This is done in a quantitative way using a six point scoring of propositions or statements. The scores ranged from 'No agreement (0) to very high agreement (5). Based on the Round 3 analysis, statements have been generated for each of the 12 value chain action areas. The 41 propositions related to the value chain as follows.

Policy framework:	6 propositions
Primary production (Farmers):	19 propositions
Processing and manufacturing:	8 propositions
Consumption:	8 propositions

The participants were given an opportunity to revise their scores based on the mean scores and standard deviations. The presentation of the propositions and the scoring is set out below.

Policy framework

Farm policy
Policy makers are part of the value chain. They set the framework conditions in which farmers, processors and other businesses operate and make decisions. In particular, payments and requirements under the Common Agricultural Policy have a profound effect on farmers' decisions. Farm policy measures can incentivise the production of grain legume crops directly by providing direct payments coupled to the legume-cropped area, or stimulate them indirectly by incentivising particular approaches to cropping.

1.1	Resistance from farm organisations (farm unions) constrains the implementation of **voluntary coupled support schemes** for legumes (area-related payments for legumes)					
	Number	15	Mean	1.47	Standard deviation	1.25

1.2	Policy makers' concerns (e.g., about cost or market distortion) constrains the implementation of **voluntary coupled support schemes** for legumes (area-related payments for legumes)					
	Number	19	Mean	3.00	Standard deviation	1.56

1.3	Resistance from farm organisations (farm unions) constrains the implementation of **whole-farm environmental payment schemes** for diverse legume-supported cropping systems					
	Number	16	Mean	2.56	Standard deviation	1.55

1.4	Policy makers' concerns (e.g., about cost or market distortion) constrains the implementation of **whole-farm environmental payment schemes** for diverse legume-supported cropping systems					
	Number	17	Mean	2.41	Standard deviation	0.94

1.5	Political resistance in society outside farming ("taxpayers") in my country/region constrains the implementation of payment schemes for farmers for legume production.					
	Number	19	Mean	1.16	Standard deviation	1.50

Environmental policy

Environmental policy is use of laws, regulations and public incentives to address the impacts of our activities on the environment. The EC's Farm to Fork Strategy is a breakthrough because of its integration of agricultural, environmental (esp. climate), food, and health policy in the EU. These include the emphasis on climate protection which will focus businesses on products' carbon footprints. Also, the implicit linking of climate policy and sustainable diets is a strong signal about dietary change.

2.1	A lack of an integrated (systems) approach to agri-environmental policy constrains the development of legumes.					
	Number	17	Mean	4.00	Standard deviation	0.94

2.2	Farm organisations' (farm unions) instinctive rejection of regulation constrains legume development.					
	Number	17	Mean	2.76	Standard deviation	1.56

2.3	The narrow focus of nutrient policy on nitrate in water constrains the development of legume-supported cropping systems.					
	Number	20	Mean	2.65	Standard deviation	1.35

2.4	Legume development is constrained by a lack of evidence of biodiversity benefits.					
	Number	18	Mean	2.72	Standard deviation	1.49

Market policy

By market policy we mean interventions in value chains to support specific market-related outcomes.

3.1	Farmers' and processors' commitment to commodity trading constrains the development of new value chains.					
	Number	20	Mean	3.45	Standard deviation	1.39

3.2	Consumers' lack of knowledge of where protein comes from constrains market development.					
	Number	20	Mean	3.50	Standard deviation	1.10

3.3	Citizens* are not willing to pay for higher social and environmental production standards.					
	Number	20	Mean	2.85	Standard deviation	1.57

3.4	Policy makers' reluctance to impact on commodity markets constrains legume development.					
	Number	19	Mean	3.68	Standard deviation	1.11

3.5	Development is constrained by a lack of ambition to use soft market instruments such as origin labelling.					
	Number	20	Mean	3.50	Standard deviation	1.19

*Note: we use the word 'citizen' instead of 'consumer' here to distinguish between individuals as political/policy actors (citizens or tax payers) and individuals as economic actors purchasing food.

Primary production - farmers

This looks at the opportunities that would be acted on specifically by farmers. These are categorised as conversion to organic farming; market opportunities that drive agricultural system change; technological opportunities that drive agricultural system change, changing farming systems; and changing cropping systems.

Conversion to organic farming

The demand for organic produce is growing. Growth in organic production is particularly relevant because legumes are almost the only managed source of reactive nitrogen into farming systems. A high proportion of legumes is required in arable rotations and grassland must have a high proportion of clover. Therefore supporting organic farming means supporting legume production.

4.1	The impact of organic farming on conventional farming is limited by a lack of relevance of organic practices to conventional.					
	Number	17	Mean	3.18	Standard deviation	1.33

Agricultural systems change

An agricultural system is the organisation between farms and other businesses over a geographic region which is characterised by common soil, climate or other circumstances.

5.1	The impact of markets for 'deforestation-free' products on legume production is constrained by the wide range of other competitive 'deforestation-free' protein sources.					
	Number	16	Mean	2.81	Standard deviation	1.42

5.2	Organic labels summarise many system features in one. For conventional products, there is a lack of product standards and labels that integrate different agricultural system features.					
	Number	20	Mean	3.20	Standard deviation	1.24

5.3	The development of legume production in agricultural systems is constrained by consumers' lack of awareness of the sourcing of protein.					
	Number	19	Mean	3.84	Standard deviation	1.01

5.4	Fixed-price contracts are bureaucratic and this constrains their impact on legume development					
	Number	17	Mean	2.00	Standard deviation	1.62

5.5	Farmers' rejection of the binding effect of fixed price contracts constrains their impact on legume production.					
	Number	16	Mean	2.38	Standard deviation	1.54

5.6	Structural change in the livestock sector (moving east) is driven by resource constraints in the west (nutrient excesses and labour costs). The impact of this on legume production is constrained by even more reliance on commodity trading in eastern regions for 'standard' meat production.					
	Number	15	Mean	3.67	Standard deviation	1.05

5.7	Small-scale on-farm legume processing technologies exist. Their impact on legume development is constrained by a higher cost compared with industrial processing.					
	Number	20	Mean	3.05	Standard deviation	1.54

5.8	**Agricultural cooperation:** The development of legumes that compete with commodity protein supplies needs large volumes. The reluctance of farmers to cooperate between themselves and with other supply chain partners to assemble this volume constrains development.					
	Number	20	Mean	3.55	Standard deviation	1.32

Farming systems change

A farming system is the organisation of individual farms. Change to lower cost farming systems was mentioned in Round 1. This includes introducing cereal-legume bi-crops for on-farm feed, introducing forage legumes, and on-farm production of grain legumes. The common driver is the reduction of costs.

6.1	Simple intensive linear farming systems constrain the development of legumes.					
	Number	19	Mean	3.89	Standard deviation	1.29

6.2	Under-valuation of the long-term economic performance and resilience of more complex/diverse and less-intensive systems constrains legume production.					
	Number	20	Mean	4.05	Standard deviation	0.89

6.3	Value chains are locked into high-input/high output systems that constrain legume development.					
	Number	19	Mean	3.89	Standard deviation	0.88

Cropping systems change

This is about change at the level of individual crops or groups of crops. Change here is ultimately about raising the on-farm performance of legume crops compared with other cropping options. This can happen by improving the performance of legumes themselves or through the decline in the performance of other crops, due for example to rotational problems. Experts also highlighted crop species in themselves as opportunities. These include lucerne and red clover as forage species that fit into arable rotations. Whole crops of faba bean, pea and cereals are also mentioned.

7.1	Compared with the standard autumn-sown crops, spring-sown grain legumes are disadvantaged by the shorter growing season and associated susceptibility to drought.					
	Number	20	Mean	3.45	Standard deviation	1.54

7.2	Legume development is constrained by a lack of appreciation and understanding of the wider benefits of spring-sown break crops in the rotation.					
	Number	20	Mean	3.60	Standard deviation	1.10

7.3	The advanced development and competitiveness of other spring-sown crops such as sunflower, maize and spring barley constrains the development of legumes.					
	Number	19	Mean	3.11	Standard deviation	1.76

7.4	The development of legumes is constrained by the fragmented breeding effort which reduces breeding/genetic progress.					
	Number	19	Mean	3.37	Standard deviation	1.21

7.5	Legume development is constrained by under-investment in breeding which reduces breeding progress.					
	Number	20	Mean	3.85	Standard deviation	0.99

7.6	The performance of legumes is constrained by farmers' lack of access to knowledge

	Number	20	Mean	2.80	Standard deviation	1.28

7.7	The performance of legumes is constrained by farmers' lack of access to technologies					
	Number	20	Mean	2.75	Standard deviation	1.41

7.8	The performance of legumes is constrained by difficulties in controlling weeds					
	Number	18	Mean	2.89	Standard deviation	1.53

7.9	The performance of legumes is constrained by difficulties in controlling diseases					
	Number	18	Mean	2.67	Standard deviation	1.19

7.10	The performance of legumes is constrained by difficulties in controlling pests					
	Number	18	Mean	2.56	Standard deviation	1.25

Processing and manufacturing

Opportunities from improved quality assessment
The assessment of grain quality does not usually recognise important quality differences, especially for food and higher-grade feed uses. Exploiting more demanding markets depends on more precise quality assessment that recognises top-grade clean legumes.

Question 8.1 is about the effect of more precise quality assessment in general.
Question 8.2 is about related effects on local or regional value chains.

8.1	The development of legumes is constrained by poor understanding of quality for specific uses.					
	Number	19	Mean	3.37	Standard deviation	1.07

8.2	Even if there was improved quality and more precise quality control, the market would still favour standardised soya and other internationally traded commodities.					
	Number	19	Mean	3.26	Standard deviation	1.15

8.3	The development of legumes is constrained by the poor connection between high-value end users and growers.					
	Number	19	Mean	3.32	Standard deviation	1.34

8.4	Poor rewards to growers who produce high quality for specific uses constrain the development of legumes.					
	Number	18	Mean	3.50	Standard deviation	1.47

8.5	Lack of access to the technology needed for precise quality control constrains the development of legumes.					
	Number	16	Mean	3.19	Standard deviation	1.05

Brand protection and corporate social responsibility (CSR)

This is about efforts firms make to meet societal expectations concerning the social and environmental performance of products. In this context, this ranges from avoiding brand-damaging scandals through to product differentiation using environmental and social performance claims.

9.1						
	Number	20	Mean	3.90	Standard deviation	0.97

9.2	The difficulty of quantifying the better environmental performance of European-sourced legumes on labels (e.g., using 'carbon footprinting') constrains legume development.					
	Number	19	Mean	3.37	Standard deviation	1.12

9.3	A lack of consumer understanding of the role of protein sourcing in the environmental impact of food constrains legume development.					
	Number	20	Mean	3.85	Standard deviation	1.14

9.4	Consumers are not willing to pay for higher social and environmental production standards.					
	Number	19	Mean	3.74	Standard deviation	0.99

Opportunities from processing technology

Experts draw attention to the scope for using new processing technology and related product lines to increase the consumption of legumes in food. This can be supported by plant breeding for relevant quality traits. On the feed side, a number of existing animal feed manufacturers have converted or partially converted feed mills to utilise native proteins, faba beans in particular.

10.1	The impact of small-scale local processing on legume production is constrained by uncertainty about processing quality.					
	Number	18	Mean	2.83	Standard deviation	1.58

10.2	The higher per-unit (e.g., per tonne) cost of small-scale processing is **not compensated** by savings from on-farm use (avoiding the middleman'). This constrains legume crop development.					
	Number	15	Mean	3.20	Standard deviation	1.32

10.3	The nutritional requirements of intensive livestock production systems can only be effectively met by industrial feed production.					
	Number	18	Mean	2.50	Standard deviation	1.54

Consumption

Opportunities from consumption change

Several experts reported that the mega-trend towards reduced livestock product consumption will further increase the demand for protein-rich food products made from grain legumes. This opportunity is affected by regulation on food processing intensity in the organic sector which limits processing options for legumes in meat and dairy analogue products.

11.1	The impact of consumption change on markets for European legumes is constrained by the food industry's access to commodity/imported sources of soya and pulses.					
	Number	18	Mean	3.61	Standard deviation	1.20

11.2	The impact of consumption change on legumes is constrained because the reduction in protein intake in meat and dairy does not result in a substantial increase in legume use in food products.					
	Number	19	Mean	3.00	Standard deviation	1.20

Opportunities from the demand for local food

Experts raised a wide range of opportunities arising generally from consumer interest in local food. By 'local' food we mean food that is marketed on the basis of any differentiation related to origin, including the distinction between European and global sourcing. The demand for 'GM-free' products and a wider interest in products based on local value chains come together. There are intrinsic risks in selling products that have some sort of local, regional or national identity that in reality depend on long global supply lines, especially for soybeans from South America.

12.1	The impact of demand for local meat and dairy products on legume production is constrained by consumers' lack of interest in feed sourcing.					
	Number	19	Mean	3.74	Standard deviation	1.10

12.2	The impact of demand for local legume-based feeds on legume production is constrained by concerns about the reliability of supplies.					
	Number	19	Mean	3.26	Standard deviation	1.10

12.3	The impact of demand for local legume-based foods on legume production is constrained by concerns about the reliability of supplies.					
	Number	15	Mean	3.00	Standard deviation	1.56

About this report

Authors: Donal Murphy-Bokern, http://murphy-bokern.com/ and Montse Costa Font, Scotland`s Rural College (SRUC)

Contact: Donal Murphy-Bokern, donal@murphy-bokern.com and Montse Costa Font, Montse.CostaFont@sruc.ac.uk

Production: Donau Soja

Permalink: http://www.zenodo.org/record/6619545

Cover image: Designed by rawpixel.com / Freepik, www.freepik.com

Citation: Murphy-Bokern, D. and Font, M. C., 2022. A Delphi study of production constraints and opportunities for legumes grown in Europe. Legumes Translated Report 5. Available from www.legumehub.eu

This report was prepared within the Legumes Translated project funded by the European Union through Horizon 2020, Project Grant Number 817634