



TRansition paths to sUstainable  
legume-based systems in Europe

# Application of Delphi for governance contexts which favour legume-supported value chains

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**Work Package:** 7

**Deliverable:** 7.3 (42)

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**Date Submitted:** 19<sup>th</sup> December 2019



TRUE has received funding from the European Union Horizon 2020  
Research & Innovation programme under Grant Agreement Number 727973.

[www.true-project.eu](http://www.true-project.eu)



## Deliverable Description & Contributors

- **Due date:** November 30<sup>th</sup> 2019
- **Actual submission date:** December 19<sup>th</sup> 2019
- **Project start date:** April 1<sup>st</sup> 2017
- **Duration:** 48 months
- **Work package:** WP7
- **Work package leader:** Bálint Balázs
- **Deliverable (D) Title:** D7.3 (D42) Application of Delphi for governance contexts which favour legume-supported value chains
- **Nature of deliverable:** Report
- **Dissemination level:** Public
- **Deliverable Description:** This Deliverable presents the result from the application of a policy Delphi and highlights how experts assess the potential of governance contexts that may favour the realisation of legume-supported value chains.
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- **Key words**
  - Legume, Delphi, Governance, Policy, Food Security,



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## Executive Summary

1. Policies are an essential and critical determinant of agri-food system functions, and the **incoherence between policies across sectors is a primary hindrance** to the transformation towards more sustainable system states. Reaching a common understanding of the policy incoherencies is the first step in engaging multiple stakeholders and decision-makers to develop more favourable policy and governance frameworks.
2. However, legume-focused policies are confusing and juxtaposed with a **complex set of social, structural, market and behavioural factors** that influence stakeholders' approaches and decisions. Therefore, new policy analysis frameworks that enable interactions and opinion formation on the science-society-policy interfaces are necessary to reach governance arrangements that can meet current and future food and nutritional security challenges.
3. **The EU policy on legumes is replete with paradox(es)**. The European agri-food system is overdependent on import legumes as a source of protein that sustains mainly the livestock sector. Our production systems do not integrate legumes properly while promoting synthetic fertiliser dependent crops to maintain environmentally inefficient feed. Even where legumes account for a significant portion of crop rotations (Canada, New Zealand) these practices promote environmentally unsustainable agri-food systems by driving the global export markets for feed for animals or meat directly.
4. For this deliverable, a panel of geographically dispersed policy experts and stakeholders were approached through a Delphi questionnaire to enable the contribution of opinions with anonymity. **Stakeholders assessed ten food policy areas identified in previous deliverables** as being the main components of the legume paradox to seek consensus around possible solutions.
5. The exercise provided a **complicated and interconnected web of the arguments** behind the legume paradox.



6. The Delphi exercise identified **three policy action areas and governance solutions with the highest potential to trigger change**: 1, investment in agri-food and -feed *research and knowledge transfer* will increase the competitiveness of protein crops and legume-based food products. 2, Preventing the *use of inorganic nitrogen fertiliser* creates incentives for more legume production. 3, *Nutrition, diet and health* policies and public campaigns that promote the inclusion of legumes in the human diet will make legumes more visible and increase imports for consumption. Overall, these three actions offer the best guidance to further develop pathways for legume-based food- and feed-systems.
7. Implementing these policies will likely have a more substantial impact on improving the consumption and production of legumes: while other policy options were not considered valuable by the stakeholders. Overall, this report's findings suggest that EU policymaking which focuses on these actions is the most effective strategy to increase production and consumption of EU-grown grain legumes.



## 1. Introduction

The low level of domestically cultivated legumes (3% of arable cropping in the EU), and the overreliance on non-taxable soybean imports creates a fundamental challenge to the economic and ecological resilience of our agri-food systems<sup>1</sup>. The EU cropping systems, dominated by cereals, are stagnating in terms of yield, and cereals lack many of the benefits offered by legumes, such as biological nitrogen fixation. In TRUE, we examine policies that facilitate the transition towards more legume-based food- and feed-systems. Throughout this report, we refer to 'policy' in a broad sense, not only considering legal regulations (Laws, Decrees, Strategies) as the policy framework, but also including public and private initiatives that aim to change or implement the framework conditions in subtle ways. Our methodology built on a four-step data gathering and policy analysis framework to enable co-creation of new governance solutions.

1. **Co-design**, via the elaboration of the **research agenda**, identifying societal and scientific research needs (D7.1). We invited a range of stakeholders, beyond the project partners, to Legume Innovation Network (LIN) workshops to incorporate a wide variety of knowledge bases. Co-design is a joint creation of targeted outputs, processes, aims, and structures of collaboration with the stakeholders.
2. **Co-production of joint knowledge generation at various levels (D7.2)**. Data and information have been collected during Case Study field and site visits to inform real-world perspectives and to inform decisions on sustainable solutions. Joint interpretation of the data gathered has been undertaken by different actors to identify various value systems. Such co-production enabled the analysis at regional and national levels, and policy interviews at the EU level will be documented, including joint reports, publications, conferences, and socio-technical innovations.

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<sup>1</sup> <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A7-2011-0026+0+DOC+XML+V0//HU>



3. **Co-creation of new governance solutions (D7.3).** A Delphi survey (reported here) has been carried out with a broad range of stakeholders. Co-creation is an overarching concept, implying the application of various types of collaboration processes between scientific and non-scientific actors to create new knowledge and practices aligned with responsible research and innovation.
4. **Co-dissemination and synthesis reflection workshops (D7.4).** Co-dissemination here refers to our continuous effort to invite stakeholders to joint synthesis exercises. The aims are to facilitate the validation, application, and reception of the results, and to decide how results are implemented.

The primary objective of this policy report (D7.3) is to present governance solutions that deliver to the expectations of different actors to guide further desirable development of pathways for legume-dependent food- and feed-systems. We investigated stakeholders' views through the TRUE Legume Innovation Network (LIN) workshops, as well as a web-based Delphi so that the range of proposed policy solutions could be assessed. Stakeholders and experts from previous regional LIN workshops (Continental (C-LIN), Germany, 21-22 November 2017; Atlantic (A-LIN) the UK, 13-14 December 2017; and Mediterranean (M-LIN), Greece, 20 April 2018) were invited to contribute to the Delphi exercise. Based on this, we iteratively identified policy recommendations for the alleviation of barriers, and the development of favourable policies and transition pathways, which are capable of promoting the production of legumes, and creation of legume-based products in the EU.

In summary, our main output is the analysis of experts' forecasts, judgments and recommendations. The main questions addressed in this deliverable include the following. 1, What are the policy challenges to increasing domestic legume production and consumption? Why are legume cultivation and consumption rates relatively low in Europe? 2, Which policies would lead to more legumes in our food system? What are the most effective policy mixes to forge pathways towards legume-based food- and feed-systems?

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## 2. Methodological background

### 2.1. Introduction to the Delphi method

The Delphi method originates from the Rand Corporation futurologists, Norman Dalkey and Olaf Helmer<sup>2</sup>. Helmer and Dalkey considered it as an experts' (tacit and explicit) knowledge aggregation procedure that can help planners and decisionmakers to inform their pragmatic choices about the future (Aligica and Herritt, 2009). The Delphi method has been devised to, “*obtain the most reliable consensus of opinion from a group of experts by subjecting them to a series of in-depth questionnaires, interspersed with controlled-opinion feedback*” (p 458, Dalkey and Helmer, 1963). Helmer further explained that “*Delphi inquiry is not an opinion poll, relying on drawing a random sample from the “population of experts”, instead, once a set of experts has been selected (regardless of how), it provides a communication device for them, that uses the conductor of the exercise as a filter in order to preserve anonymity of responses*” (p 19, Helmer, 1977).

Through a structured future-oriented communication process, Delphi enables the integration of individual expert opinions into a shared worldview. It thus helps the exploration of a problem space without pushing a quick compromise. The main benefit of Delphi, as Rikkonen et al. (2006a and b) contends, is that it enables relatively quick consensus solution-seeking. Furthermore, it provides sensible descriptions about future decisions, and it is in this sense that it can act as a decision-support tool. The structured process meant that a Delphi invited experts into a communicative-learning process, that enables opinion formations in anonymity, provides feedback and space for dialogue. Thus, Delphi can avoid social-psychological dominance.

A particular type of Delphi explores policy. The policy Delphi, according to Rayens and Hahn (2000), is a systematic method for obtaining, exchanging and developing an informed opinion on a policy issue. It is about assessing policies, or in a broader sense, any institutional problem (such as the legume paradox and puzzle (Balázs et al., 2017), and the argumentations around its possible solutions. Raynes and Hahn (2000), further emphasise the consensus-seeking aspect of this process for or against policy issues, while de Loe (1995) outlines that it creates opportunities for a future

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<sup>2</sup> [https://en.wikipedia.org/wiki/Olaf\\_Helmer](https://en.wikipedia.org/wiki/Olaf_Helmer)



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policy decision. Authors in the published literature differentiate four main types/aspects of policy Delphi. In an Argumentative Delphi (Kuusi, 1999), the outcomes are consensual, evidence-based arguments. Thus, Argumentative Delphi can help policymaking, as panel members are known to each other and researchers/facilitators directly generate debate about the conflicting points. In contrast, a Disaggregative Delphi (Tapio, 2003) provides the clustering of diverse opinions, and researchers attempt to outline various scenarios. In a Trend Modelling Delphi, experts assess current trends, while in a Structural Modelling Delphi, they assess causal linkages to create a new mental or conceptual model.

The main benefits of the Delphi, according to Landeta (2006), are as follows: social dominance is avoided, a plurality of viewpoints emerge, feedback loops enable a learning journey for participants, and also some statistical methods can be used in aggregating opinions.

The main challenges of a Delphi are subjectivity (it often reflects the subjective view of the summarising experts), confirmation bias (tendency to select the arguments according to summarising experts' preconception), and interest (in general researchers' interests might be overrepresented compared to other stakeholders).

## 2.2. Delphi for food policy

How to shape a better agri-food environment that promotes ecologically sustainable food production through policies, is a longstanding objective of food policy research and Delphi has been often deployed in this context. In 2015, international food policy experts assessed good food environment policies regarding their effectiveness in a Delphi study run by Mahesh et al. (2018). Food prices and promotion were found to be the most valued policy domains with regards to impact on improving population nutrition. Interestingly, trade received the lowest weighting. As for specific policies, taxing unhealthy foods and promoting healthy food provision in schools are the most highly valued. Whereas, nutrient declarations on packaged foods and healthy food policies in private-sector workplaces received the lowest weightings. Tiberius et al. (2019) explored the potential development of cultured meat by 2027. The Delphi study participants doubted that challenges regarding mass production, production costs, and consumer acceptance would be overcome by 2027.



Considering the noticeable impacts of global warming, as well as changes in consumer perceptions, continued research and development into environmentally sustainable food systems is inevitable. In an expert Delphi, Antonelli et al. (2019), explored trends, challenges, and policy options in the agri-food sector in the Mediterranean region over the short (to 2020) and the long term (to 2030) by developing pessimistic versus optimistic scenarios. The assessment of country-of-origin labelling policy mobilised 19 food policy experts from 13 countries in a consensus-seeking Delphi (Su and Canavari, 2018). Based on expert knowledge, the multiple countries of origin labels can give accurate information about the origin of food produced by two or more countries, avoiding misinformation for consumers. In the TRANSMANGO EU project, 45 international food policy experts participated in a Delphi to identify global drivers of the food system affecting EU food and nutrition security. According to Moragues-Faus et al. (2017), there seems to be a broad consensus around the FAO definition of food and nutrition security (identifying it with access, availability, and sustainability). However, much less consensus could be recorded about the food system, which is understood dynamically - either as actor-oriented (different agents play the lead), food chain oriented, or systemic (a mixture of stakeholders, flows, material devices, institutions, norms, beliefs and activities). Note that only a few respondents refer to “intangible” dimensions of the food system in their definitions; governance, culture, environmental externalities and knowledge. Allen et al. (2019) propose sustainable food system metrics in the context of the Mediterranean area and involved experts to gather consensus in a Delphi survey regarding the indicator selection process. Frewer et al. (2011), suggest exploratory workshops to refine Delphi questions and show that beyond the relevance of the issue to the invited participant, response rates could be increased by leveraging personal networks. They also note that policy uptake of the outputs of Delphi merits further research. Boylan et al. (2019) explored the perceptions and role of the Australian policy actors on a healthy, sustainable and safe food system in a Delphi survey. They recorded a critical consensus on the definition and essential elements of a cross-sectoral food and nutrition policy to meet today’s environmental, health, social and economic challenges.

Agri-food policy development could benefit from soliciting expert opinion and consensus solution-seeking by utilising a Delphi. While consumer engagement in food and health policy development is rare, the public discourse about policy options for healthy eating or against obesity is dominated by

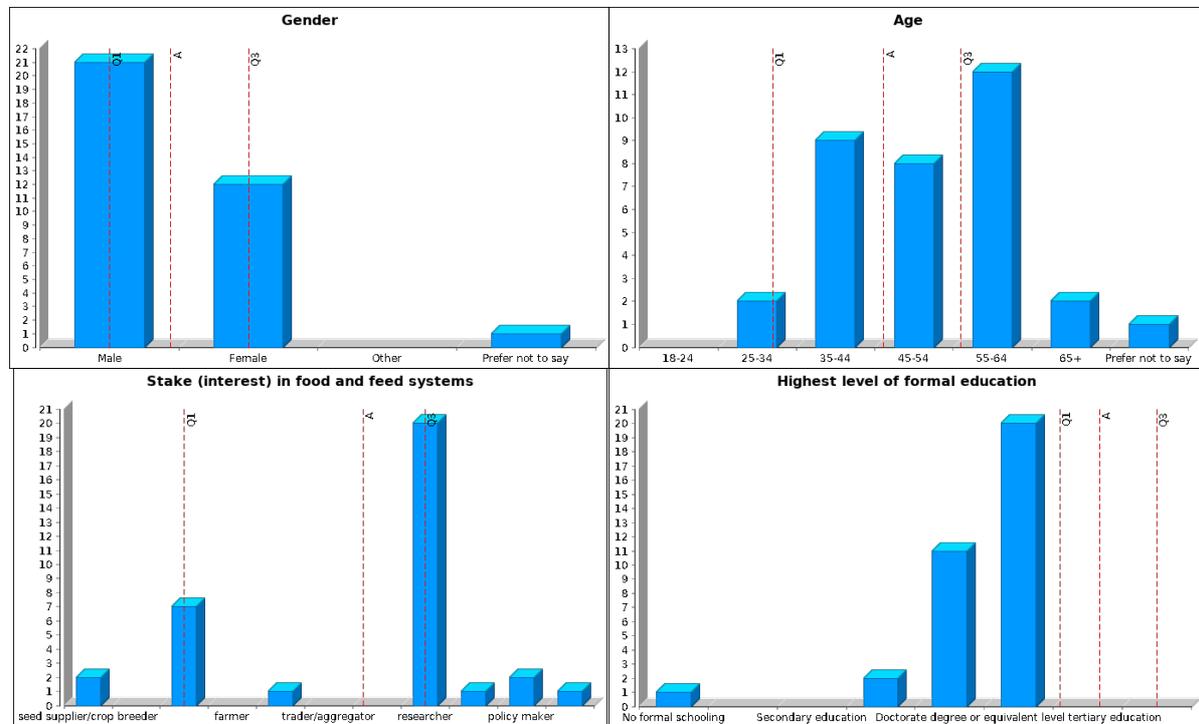


industry and government stakeholders. Haynes et al. (2016), explored the consensus on obesity policy priorities of underrepresented stakeholders in the Australian context. In a three-round online policy Delphi, consumers, public health practitioners and policymakers prioritised obesity options. In a final face-to-face discussion group, participants explored stakeholder perceptions of the intrusiveness (ethical acceptability) of obesity policy options. Hung et al. (2019), investigated the challenge of improving consumer motivation and interest in healthy eating by using nutrition labels (health claims and symbols). Evidence-based policy recommendations and communication guidelines have been derived from the findings of the EU FP7 project CLYMBOL (*“Role of health-related CLaims and sYMBOLs in consumer behaviour”* Grant Agreement Number 311963) and assessed by European stakeholders in a three-round Delphi. Health claims with shorter and less complicated messages and health symbols with a visible endorsement were the most highly valued.

### 2.3. The role of Delphi in TRUE

There are two main aims of the Delphi in the TRUE project: 1, obtain a consensus among a group of geographically dispersed policy experts and stakeholders during the assessment of 10 food policy areas identified in previous deliverables (Balázs et al., 2017; 2019); and 2, enable participants to contribute their opinions with anonymity. We chose the eDelphi open-source software (eDelphi.org) that is based on the activity of the users and the user community. Participants were invited in a personal email (Annex I), which resulted in 80 experts accepting our invitation (see Figure 1 on the demographics of experts). This Deliverable report sums the results of the first Delphi round. However, it should be noted that another round of Delphi questions will be circulated to invited experts to refine and/or verify our conclusions in 2020.

Figure 1. Basic demographics (gender, age, stake and education) of the participant experts.<sup>3</sup>



The first online round of questionnaires was circulated after the second M-LIN meeting in Porto (Portugal, July 2019). The main aim was to verify our previous policy insights (Balázs 2017; 2019) and assess our policy conclusions thus far. The first results have been presented and validated at the “Policy” session of the first *European Conference on Crop Diversification* which was held on the 17<sup>th</sup> of September 2019 (Budapest, Hungary; [www.cropdiversification2019.net](http://www.cropdiversification2019.net)), with the participation of the policy experts of the Crop Diversification Cluster (CDC; [www.cropdiversification.eu](http://www.cropdiversification.eu)). In October 2019, preliminary results were presented at the “Sustainable Diets versus Sustainable Food Systems Conference”, in Rome (<https://graduate.aur.edu/events/conference-sustainable-food-systems-sustainable-diets>), in the session, “How to enable sustainable diets”.

<sup>3</sup> Note: In a Delphi, panelists do not have to answer all the questions, and it is even recommended not to answer questions where they do not feel competent. In case of missing answers at the demographic questions it may be influenced by the desire to maintain complete anonymity.



## 2.4. The questions of Delphi in TRUE

As a first question, we asked in an open format: *“In your opinion, why are legume production and consumption so low in Europe? Please give a short explanation of your own words“*. In using this approach, experts could enter their opinions or convictions before the actual specific policies were introduced. Next, we extracted ten critical questions from our previous studies (Balázs 2017; 2019) and asked experts to assess them. To broaden dialogues, we stated that by discussing legumes, the assessments should not be about protein only, as legumes are about starch, fibre, minerals, and other ‘non-nutritional’ factors, which may affect physiological and ecological functions too. The ten statements are all based on current policy trends documented in research studies or reports about legume cultivation and consumption in Europe. Experts were asked to assess the statements on a 5-step scale from two distinct points of view: expected probability and impact towards legume-based food systems. Firstly, the participants considered whether a specific policy would lead to more legumes in our food system. The probability that the policy leads to more legumes in our food system needed to be judged on the following scale: 1=very improbable, 2=improbable, 3=neutral, 4=probable, 5=very probable. Second, the participants were asked to assess how much impact a specific policy has on our food system. The strength of its impact on our food system needed to be judged, such as: 1=very low, 2=low, 3=moderate, 4=high, 5=very high. From questions 1-10, we explored attitudes towards scientific evidence on the legume paradox. In the comments, we asked participants to describe the thinking behind their choices. Here they could enter any alternative perspectives and disruptive ideas about policy prospects. Once participants submitted their assessments, the responses of other participants were made visible, so that then they could choose to alter or add to their answers if needed.



## 2.5. Data used for the Delphi analysis

Data files of the Delphi are available for further analysis via the website links below.

- The results of the first round Delphi (pdf format)  
<https://www.dropbox.com/s/jd1saljjxsvwb0v/D7.3%20-%20Appendix%20-%20Delphi%20first%20round%20results.pdf?dl=0>
- The data spreadsheet of the first round Delphi (raw data and diagrams)  
[https://docs.google.com/spreadsheets/d/17BQmfJZWRYaQpbQzL3NPs9CgG5aQtu85lasuZb\\_fxXw/edit?usp=sharing](https://docs.google.com/spreadsheets/d/17BQmfJZWRYaQpbQzL3NPs9CgG5aQtu85lasuZb_fxXw/edit?usp=sharing)

### 3. Analysis of the first Delphi

#### 3.1. The system lock-in

In the first round of the Delphi survey (running between 1<sup>st</sup> September and 10<sup>th</sup> October 2019) we aimed first at exploring the significant factors contributing to the relatively low production and consumption levels of legumes in Europe, and the second round, at outlining the potential target areas of policy intervention, where future actions could support the production and consumption of legumes.

The open question on: “*Why are legume production and consumption so low in Europe*” resulted in a considerable number of answers, some specified only to production, others to consumption, while some remained at the system level. Narrative answers were first coded (40 *in vivo* codes were used), then categorised, and finally mapped into a mental model showing logical links between the different categories. In Figure 2 we share a word cloud representing the codes used in the analysis where the size of the letters indicates the frequency of the code.



**Figure 2.** Word cloud representing the codes used in the analysis where the size of the letters indicates the frequency of the code.

If we were to summarise the results of the Delphi survey with one expression, the primary reason for the relatively low level of production and consumption of legumes in Europe is, “a system lock-in”. This means that at both the production and the consumption side, there are significant barriers which limit the uptake of legumes and result in a ‘chicken-and-egg’ problem:

- production is low because legumes are not competitive enough (compared to other crops) due to lack of demand, but at the same time;
- consumption is low because legumes are not attractive enough (compared to meat and other food products) due to the lack of innovative products.

As one respondent stated, there are “bottlenecks at the value chain” driving the European agro-feed and -food system away from legumes. Based on the answers such bottlenecks (or barriers) exist at all links in the value-chain, including with the breeding, the production, the processing, the trade and the consumption stages. Barriers also exist at the level of regulating policies, and by nature, these can be technological, cognitive, economic, political or cultural. In Figure 3, a schematic picture of the mental map, created from the narrative answers, explains how specific barriers at different stages of the value chain limits the production and consumption of legumes.



Figure 3. Mind map of codes used in the analysis.



Starting with production, the general reason for not producing more legumes is that they are not profitable or competitive enough compared to other crops or other farming systems. Lack of profitability is an economic barrier at the farm level, but also the broader scales of national and/ EU economies. At the farm level, farmers' choice of what to produce depends on the knowledge and familiarity with the crop and the farming system, as well as the health and productivity of the crop. In the case of legumes, there are technological and cognitive barriers already at farm level due to lack of knowledge on how to produce and keep legumes healthy. For many farmers producing legumes would require a change of production system (and at larger scales would demand a move away from a strong focus on producing for mainly livestock production within the EU, which is less profitable than cultivation for food). This is also difficult because there are not currently enough suitable legume varieties that can provide stable yields across the range of climatic conditions. Altogether, barriers at the level of production mean that cultivating legumes is riskier than choosing other non-legume crops. This barrier is strengthened by current agricultural policies in the EU and many of its member states, as subsidies/payments are more incentivising for other crops than for legumes. Without substantial financial support, the economic risks of producing legumes remain solely on the shoulders of the producer. Additional factors contributing to the lack of profitability is the relatively low price of inorganic nitrogen fertilisers and importation of large volumes of soybean which sets the price for legumes for animal feed (the dominant market demand) at a very low level. These factors both act as economic barriers at the farm level but might also be considered as technical or political lock-ins at the system level.

Moving along the value chain, further barriers emerge when legumes enter the market either in raw form or via processing. As respondents stated, the legume market is considered as a niche market in Europe, with very few market channels (except for soybean). Processing facilities are lacking, which results in a shortage of new, innovative legume-based food- and feed-products. In addition, the marketing of legumes is weak, which contributes to an outdated image of legume-based products among consumers. The lack of demand for legume-based products is considered a general limitation by many respondents, which can be traced back to cultural factors, such as through the generations legumes were devalued and considered as poor man's food; cognitive factors, such as the lack of knowledge of legumes' health benefits and shortage of appealing recipes; and technical aspects, such as cooking legumes is time-consuming, and that legumes are not considered as

attractive as meat-based products. These barriers are sometimes strengthened by nutritional policy and advice, at least in those countries where meat and milk-based products are considered the best sources of protein. Table 1 provides a quick overview of what type of barriers experts see at different stages of the value chain.

**Table 1.** *Bottlenecks along the legume value chain where: xx, strong barrier; x, weak barrier; -, barrier not present)*

Value chain	Type of barriers				
	Technological	Economic	Cognitive	Cultural	Political
<b>Breeding</b>	xx	-	x	-	-
<b>Production</b>	x	xx	xx	x	x
<b>Trade</b>	-	xx	-	-	x
<b>Processing</b>	xx	x	-	-	-
<b>Consumption</b>	-	-	x	xx	x

These significant barriers also outline some routes for potential interventions, as follows.

- Improve the profitability of legume production via:
  - o increased policy support of legume production (i.e. payments for positive environmental externalities or higher taxes on mineral fertilisers);
  - o increased policy support of legumes compared to imported protein crops (i.e. via requiring imported protein crops to meet the same environmental standards);
  - o improved the advisory system to provide more information and practical knowledge to farmers on how to produce legumes efficiently; and,
  - o novel breeds, potentially building on traditional locally adapted varieties, which meets requirements of reliable yield, plant health and adaptability to climatic change.
  
- boost the demand for legume-based products via:
  - o creating novel products (both feed and food) that meet consumer preferences (i.e. processed food which is tasty and easy and quick to prepare);
  - o branding legume-based products as trendy and healthy to improve the attractiveness of such products;
  - o (co-)creating and sharing new knowledge about the benefits of legumes on human and planetary health with consumers; and,
  - o including legumes in dietary recommendations at the policy level.



### 3.2. Spaces for policy interventions

In the second part of the first Delphi survey, we asked respondents to assess ten statements outlining different policy scenarios along two aspects: *probability*, what is the probability that the policy leads to changes in legume production and consumption; and *impact*, what kind of impact the policy could have on legume production and consumption. Figure 4 presents the summary of how stakeholders score the probability that a specific policy will trigger change and its impact. In order to calculate the average (AV) and standard deviation (SD) scores, all responses on probability (from 1=very improbable to 5=very probable) and on impact (from 1=very low to 5=very high) were first converted to a minus/plus scale ranging from values of minus 2 to plus 2.

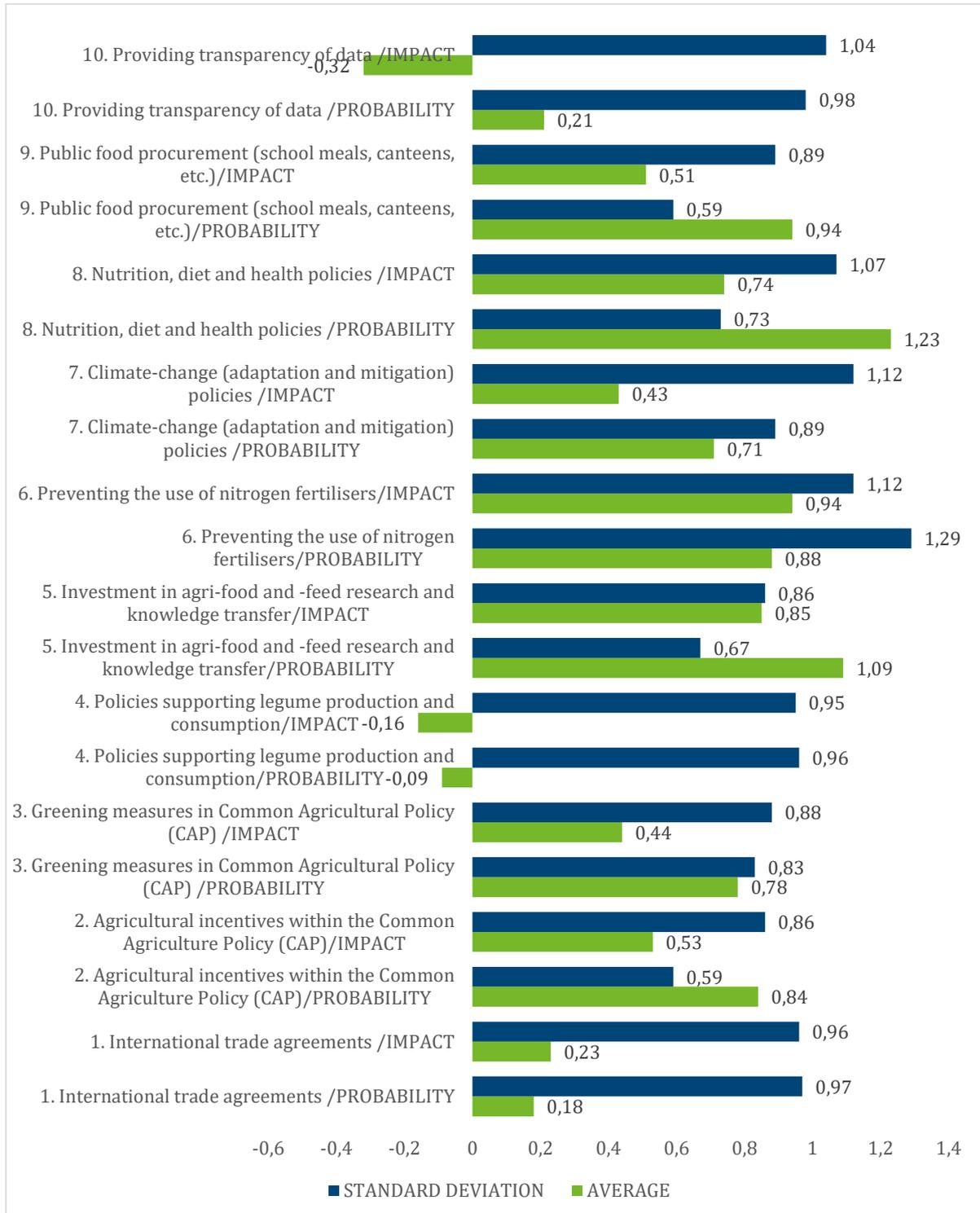
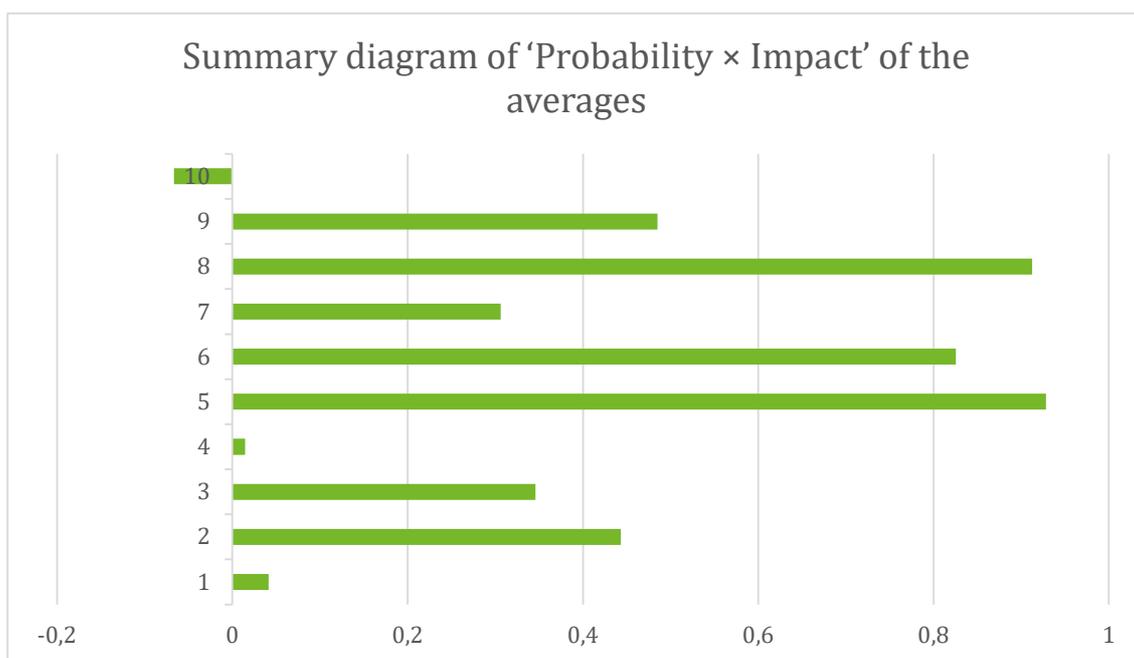


Figure 4. Summary diagram of the Impact and Probability (AV, SD) that a policy will trigger change.

The assessment of some statements proved to be almost unanimous, for example, number 2, agricultural incentives in (Common Agricultural Policy) CAP; number 3, greening measures in CAP; number 5, investment in research and knowledge transfer; and number 9, public food procurement. However, there were policy interventions which triggered contesting scores and comments such as number 1, changing international trade agreements; number 4, policies supporting both legume production and consumption; number 6, preventing the use of inorganic nitrogenous fertilisers; number 7, climate change policies; and number 8, nutrition, diet and health policies; and number 9, transparency of data. In the following sections, we discuss each policy statement individually, giving more emphasis to those where expert judgment on probability and impact was highly variable.



**Figure 5.** Summary diagram of 'Probability × Impact' of the averages.

Based on the summary diagram in Figure 5 above, three main clusters can be differentiated with regards to Probability × Impact scores of the assessment of the experts on specific policies. This assessment points towards mixes of policy areas and policy windows ranging from low to high efficiency in triggering a transformation in the system, and potentiality in breaking the systemic lock-ins.

**High potential policies (Probability × Impact; scores above 0.5).**

- Investment in agri-food and -feed research and knowledge transfer will increase the competitiveness of protein crops and legume-based food products.
- Preventing the use of inorganic nitrogen fertilisers create room for more legume production.
- Nutrition, diet and health policies and public campaigns that promote the inclusion of legumes in the human diet make legumes more visible and increase imports for consumption.

**Medium potential policies (Probability × Impact; scores between 0.25-0.5).**

- Agricultural incentives within the Common Agricultural Policy support farmers growing plant proteins.
- Green direct payments of the CAP help the sustainability transition of the food and feed system.
- Climate change policies help reducing meat production and consumption while increasing legume cropping and decrease emissions from inorganic fertiliser.
- Public food procurement offers more healthy options in foodservice markets that help the shifts towards legume-based diets.

**Low potential policies (Probability × Impact score below 0.25).**

- Changing international trade agreements would reduce the EU's dependency on non-taxable soybean imports.
- Policies supporting legume production and consumption also increase industrialised livestock production (the low value is based on negative average impact and a negative average probability that stakeholders gave to this policy).
- Providing transparency of market data help boost legume supply chains (the negative value of this score is the result of the negative average impact that stakeholders gave to this policy).

Source of the tables and figures:

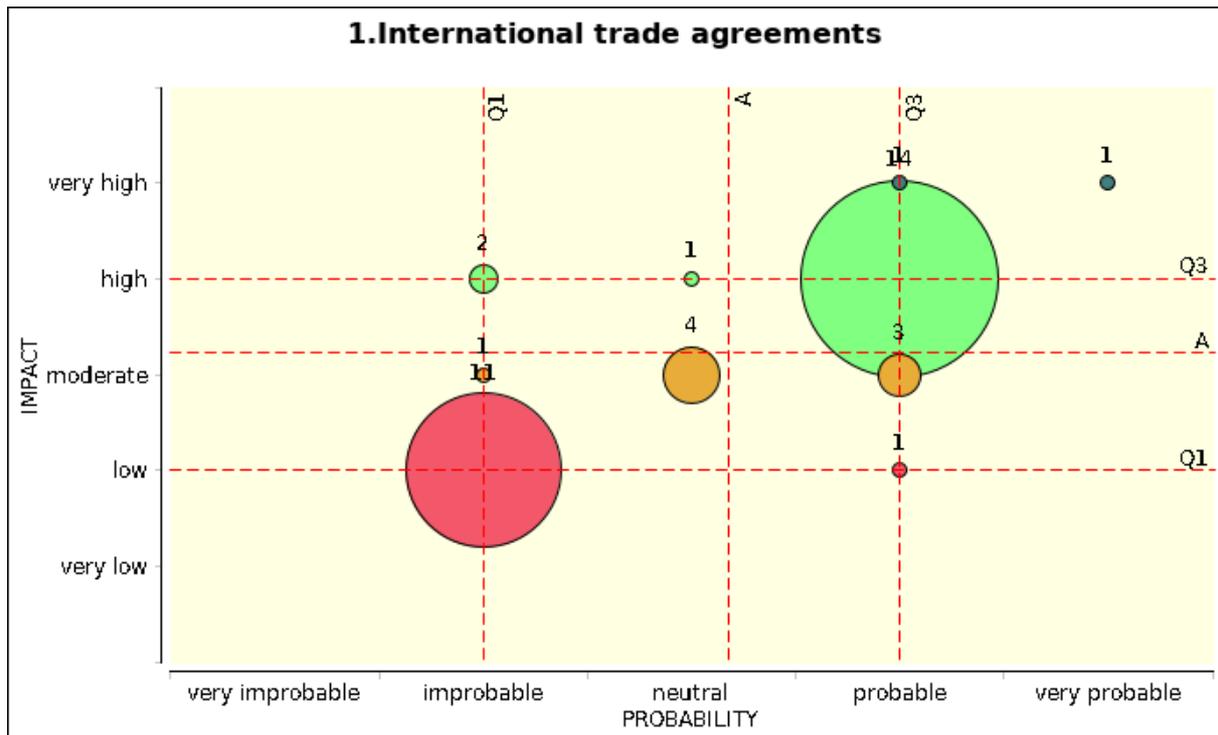
[https://docs.google.com/spreadsheets/d/17BQmfJZWRYaQpbQzL3NPs9CgG5aQtu85IasuZb\\_fxXw/edit?usp=sharing](https://docs.google.com/spreadsheets/d/17BQmfJZWRYaQpbQzL3NPs9CgG5aQtu85IasuZb_fxXw/edit?usp=sharing).

In the following, we provide a detailed analysis of each policy area and its potentiality.

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3.2.1 Changing international trade agreements would reduce the EU's dependency on non-taxable soybean imports?

Figure 6.



	1. International trade agreements /PROBABILITY	1. International trade agreements /IMPACT
AV <sup>4</sup>	0.18	0.23
SD	0.97	0.96

<sup>4</sup> To calculate the average (AV) and standard deviation (SD), all responses on probability (from 1=very improbable to 5=very probable) and on impact (from 1=very low to 5=very high) were first converted to a minus/plus scale ranging from minus 2 to plus 2.



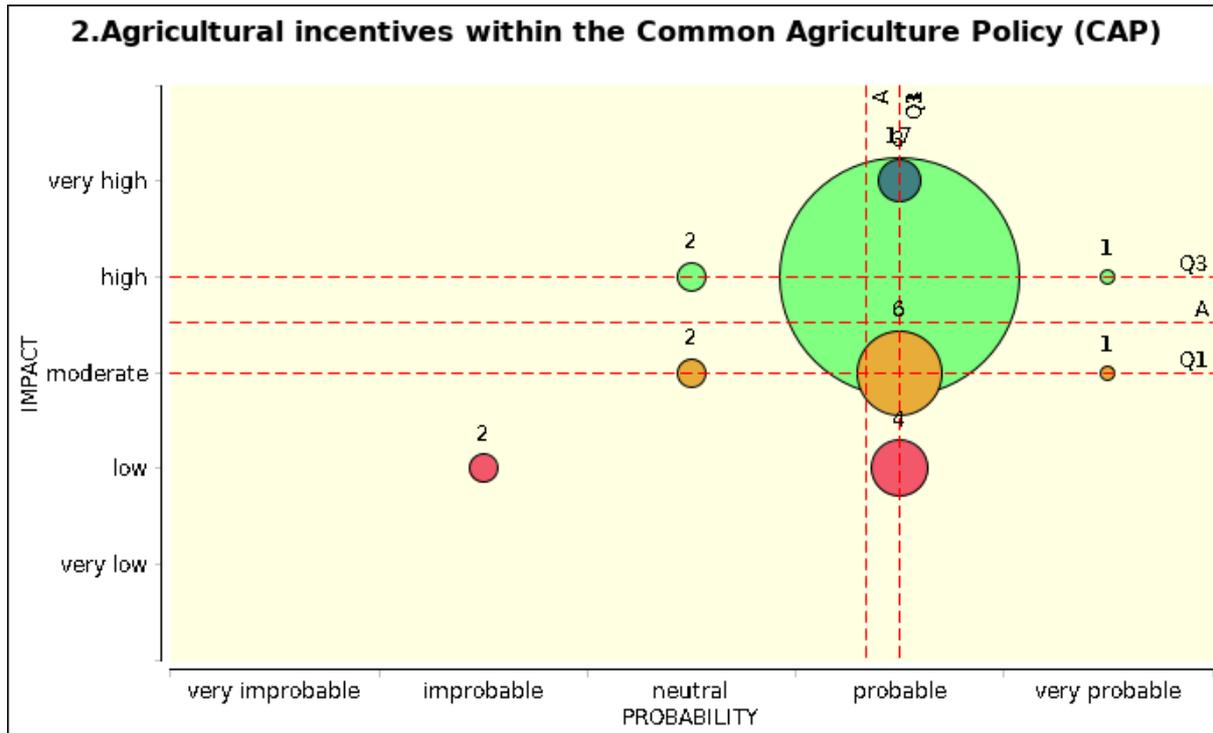
.....

This statement was among the most contested, with two distinct groups of responses: either considering it a probable intervention with high impact, or a rather improbable intervention with low or very low impact. Dominant narratives underlying the first group acknowledged that currently, import soybean sets the price level for protein crops in the EU (especially processed for feed). Therefore, any intervention which closes the gap between the prices of import and domestic protein crops could contribute to increased profitability of legume production within the EU. However, many responses highlighted that such an intervention would go against free trade agreements and was considered impossible if solely focused on price. Instead, environmental or safety regulations could be tightened for import products (e.g., no GMO) to levelling the playing field for domestic products. Those considering this statement improbable and less impactful pointed to the fact that current livestock production in the EU is dependent mainly on import soy, so if feed prices increased, that would have a substantial impact on the competitiveness of meat products exported beyond the EU. Complex interrelationships within a globalised market were seen as essential reasons why caution is needed in any changes in the international trade agreements.

- Suggested statement(s) for the second round of the Delphi: **Increasing environmental, ethical and safety standards for imported raw protein sources (used either for feed or food) closes the profitability gap between imported and homegrown legumes.**

**3.2.2. Agricultural incentives within the Common Agricultural Policy support farmers growing plant proteins**

**Figure 7.**



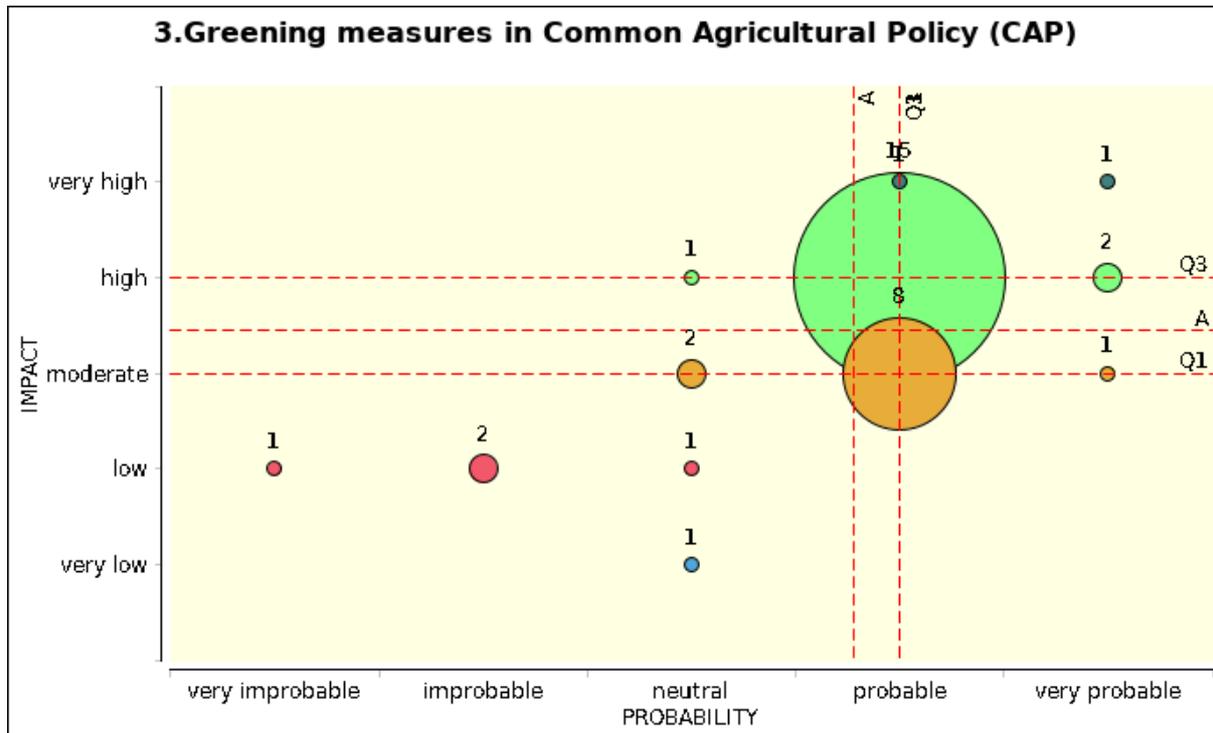
	2. Agricultural incentives within the Common Agriculture Policy (CAP)/PROBABILITY	2. Agricultural incentives within the Common Agriculture Policy (CAP)/IMPACT
AV	0.84	0.53
SD	0.59	0.86



Although there was a slight variability among answers, this statement was mostly considered as a probable policy intervention having a moderate impact on legume production and consumption. Responses highlighted that financial support via the CAP could decrease the gap between cereals and legumes (in terms of risks and profitability), and therefore could make legumes a more attractive choice for farmers. However, as the EU's agriculture is firmly focussed on livestock production, such interventions might have the most substantial impact on legumes for feed and not for food. Although considered impactful, some respondents also mentioned that *"incentives do not heal the market"*. That is, if the increased production is not met with growing demand, only surpluses are produced. Therefore, to make such an intervention impactful, market opportunities should also be created at an increasing rate. Some respondents also warned that agricultural incentives should focus on sustainable production; otherwise, we only replace current unsustainable protein crop production from South America to Europe.

3.2.3. Green direct payments of the CAP help the sustainability transition of the food and feed system

Figure 8.



	3. Greening measures in Common Agricultural Policy (CAP) /PROBABILITY	3. Greening measures in Common Agricultural Policy (CAP) /IMPACT
AV	0.78	0.44
SD	0.83	0.88

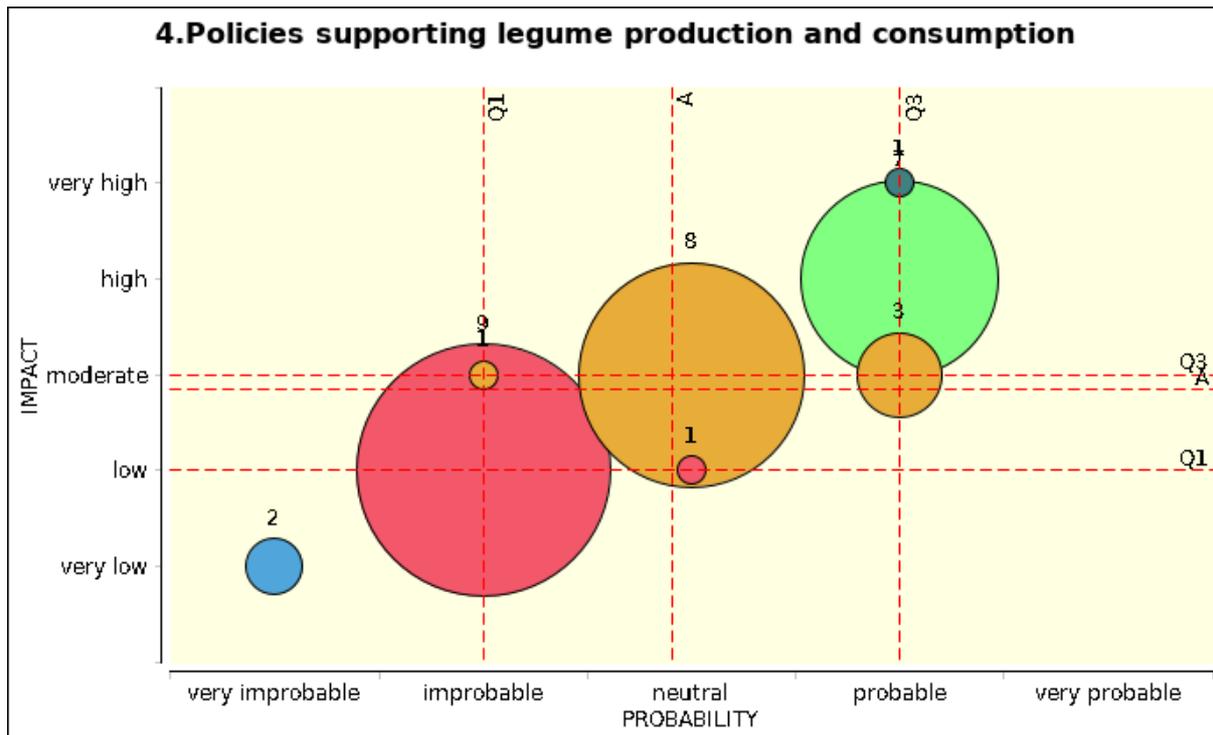


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Greening measures were considered a moderately impactful intervention which has already been in practice in the EU. Respondents considered the greening measures as being in line with the EU's commitments to SDGs and bioeconomy and could easily be linked to carbon and climate issues. Therefore, they seem to be plausible to exist in the long run. Some responses highlighted that greening measures show some variability across countries and might induce strict rules (e.g. Ecological Focus Areas) which are challenging for conventional farmers of legumes to meet. Two major conditions were identified which could help make greening measures to be more effective, such as 1, applying a systems perspective that enables a shift towards sustainable agriculture (and not just some minor alterations of the current unsustainable paradigm); and 2, having a long-term approach which provides time and professional advice to farmers throughout a transition until they shift their production to include more legumes.

3.2.4. Policies supporting legume production and consumption also increase industrialised livestock production

Figure 9.



	4. Policies supporting legume production and consumption/PROBABILITY	4. Policies supporting legume production and consumption/IMPACT
AV	-0.09	-0.16
SD	0.96	0.95

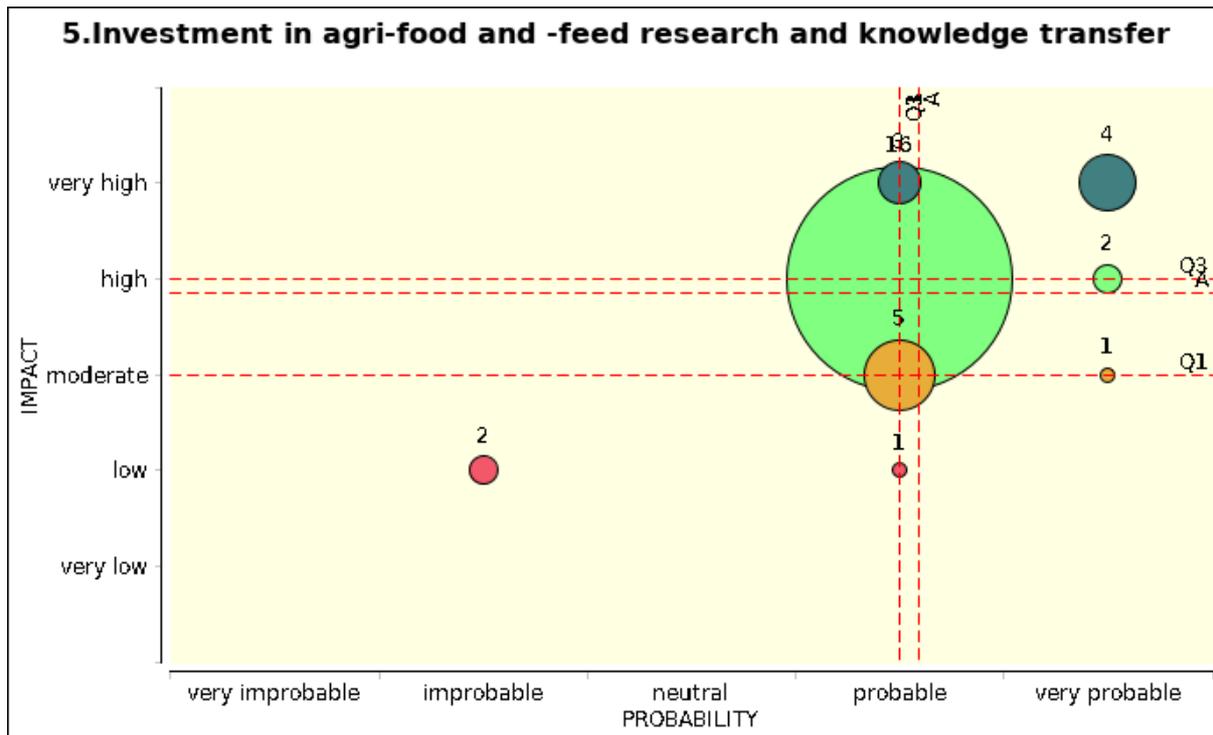


This statement induced substantial heterogeneity in the answers, mainly because respondents found it vague, ambivalent and not fitting to the scales of evaluation. Some of the answers highlighted that an increase in domestic production of plant proteins could benefit livestock production (although this depends on the type of plant and climatic conditions), but at the same time might also exacerbate environmental problems. To have an impact on livestock production, stable and reliable quality and quantity of raw protein is needed, which is now true for imported soybean, but would need further development for domestic legume production (i.e. how to use other legumes, such as lupine, as feed). Others stated that consumption-focused policies (esp. those focusing on sustainable diets and environmental limits) might have a stronger impact on the legume food- and feed-chain than incentivising production – although this could induce a decrease of intensive livestock production. As a general message, we could state that large scale production of protein crops for the primary use of animal feed might not be possible/competitive in Europe, and at the same time might not be desirable if sustainable agri-food and -feed chains are the target. Therefore, any policies targeting the production of plant protein for feed should also build in requirements for sustainability.

- Suggested statement(s) for the second round of the Delphi: **Applying stricter environmental and climate regulations (e.g. carbon tax and/or the soil directive) for crop- and livestock-production in Europe can ensure that agricultural policies targeting the homegrown production of protein crops (i.e. protein strategies) avoid unintended adverse impacts on the sustainability of European livestock production.**

3.2.5. Investment in agri-food and -feed research and knowledge transfer increases the competitiveness of protein crops and legume-based food products

Figure 10.



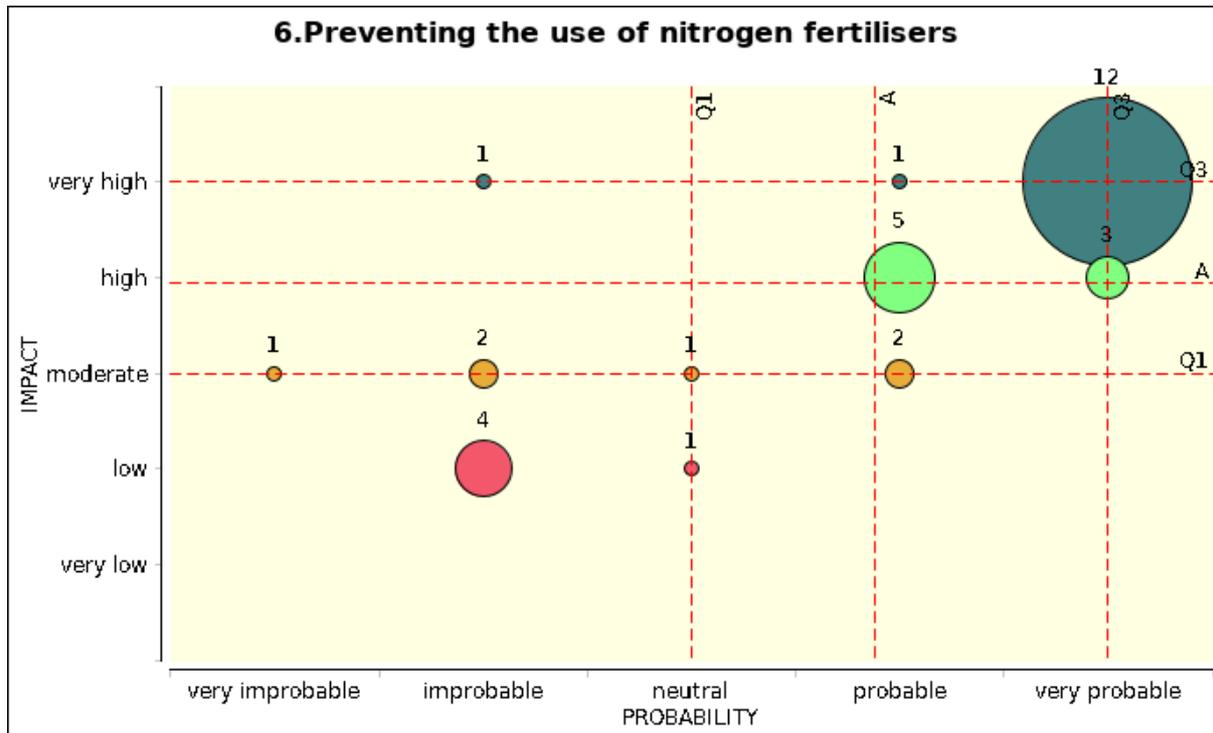
	5. Investment in agri-food and -feed research and knowledge transfer/PROBABILITY	5. Investment in agri-food and -feed research and knowledge transfer/IMPACT
AV	1.09	0.85
SD	0.67	0.86



Investment in agri-food and -feed research and knowledge transfer were seen as an effective and feasible intervention. A key added value of such an investment is the potential to close the yield/profitability gap between legumes and cereals, therefore making legumes more competitive on both the feed- and the food-markets. Developments could focus on: breeding of improved (locally adapted) varieties; the utilisation of components individually such as protein, amino acids, carbohydrates, lipids and fibre etc.; the revitalisation of traditional knowledge; the adaptive capacity of different varieties to changing climatic conditions; and, the environmental impacts of legume production. Respondents also highlighted that there is a recent increase in R&D activities for legumes, but to have a real impact this new knowledge must be shared with other players along the value chain (especially farmers and consumers). Therefore, knowledge transfer is equally, or even more important than research, and needs to be organised systematically: for example, as through extension services. Nevertheless, even given the accepted importance of new knowledge, responses indicated that research and knowledge transfer are themselves not able to change the market, especially considering the current small share of legumes in the food system.

3.2.6. Preventing inorganic nitrogen fertilisers create room for more legume production

Figure 11.



	6. Preventing the use of nitrogen fertilisers/PROBABILITY	6. Preventing the use of nitrogen fertilisers/IMPACT
AV	0.88	0.94
SD	1.29	1.12

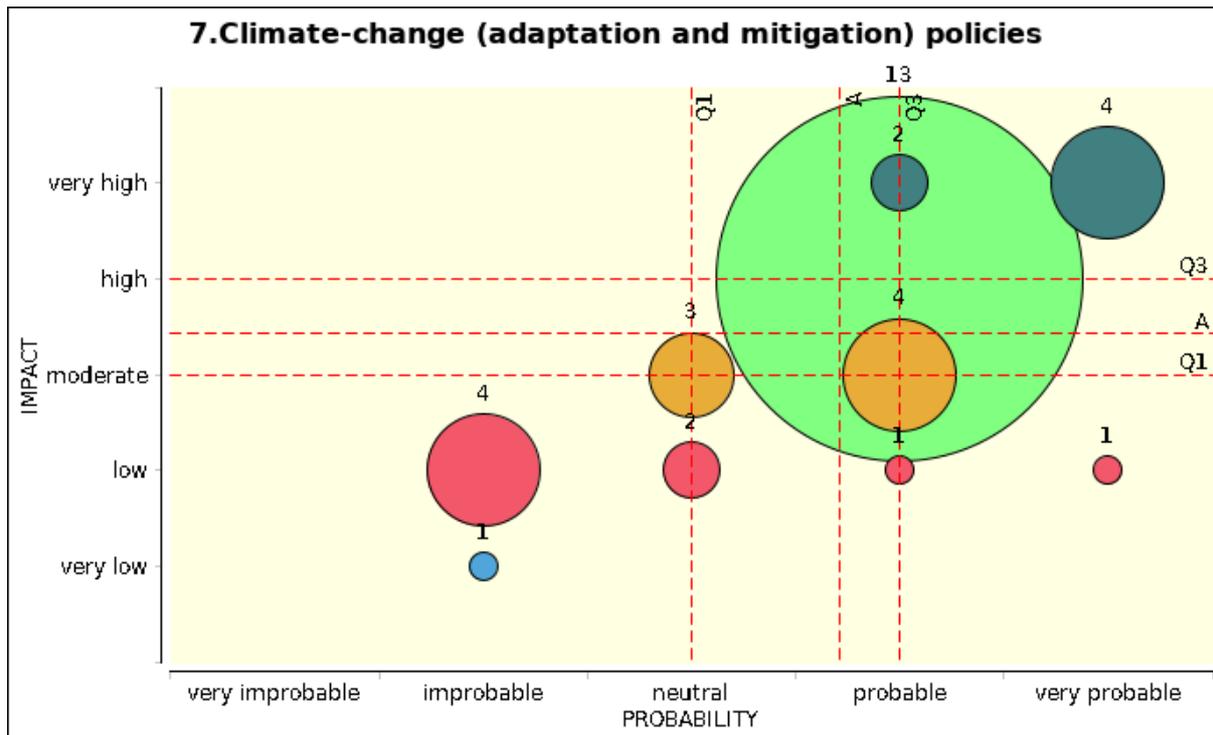


Nitrogen fixation was considered a specific benefit of legumes, which could be put into the focus of policy intervention (e.g., as part of the EU's climate action) because inorganic fertilisers used in modern agriculture cause severe environmental problems. To many respondents, restricting the use of inorganic nitrogen seemed likely to produce a drastic change in farmers' behaviour (towards producing more legumes), but how to make such a shift was questioned. One complication is that a ban on inorganic nitrogen might have a very negative effect on cereal production (decreasing domestic yields and increasing prices), causing a crisis in EU agriculture. Additionally, imposing and monitoring such a restriction would be difficult.

- Suggested statement(s) for the second round of the Delphi: **Focusing research and development on more effective crop rotation schemes, and options to better recycle nitrogen, opens a policy window to launch reward systems - which if accompanied with farm advisory/extension services for farmers, will encourage reduced inorganic fertiliser use by increasing legume production.**

**3.2.7. Climate change policies help reducing meat production and consumption while increasing legume cropping and decrease emissions from inorganic fertiliser**

**Figure 12.**



	7. Climate-change (adaptation and mitigation) policies /PROBABILITY	7. Climate-change (adaptation and mitigation) policies /IMPACT
AV	0.71	0.43
SD	0.89	1.12

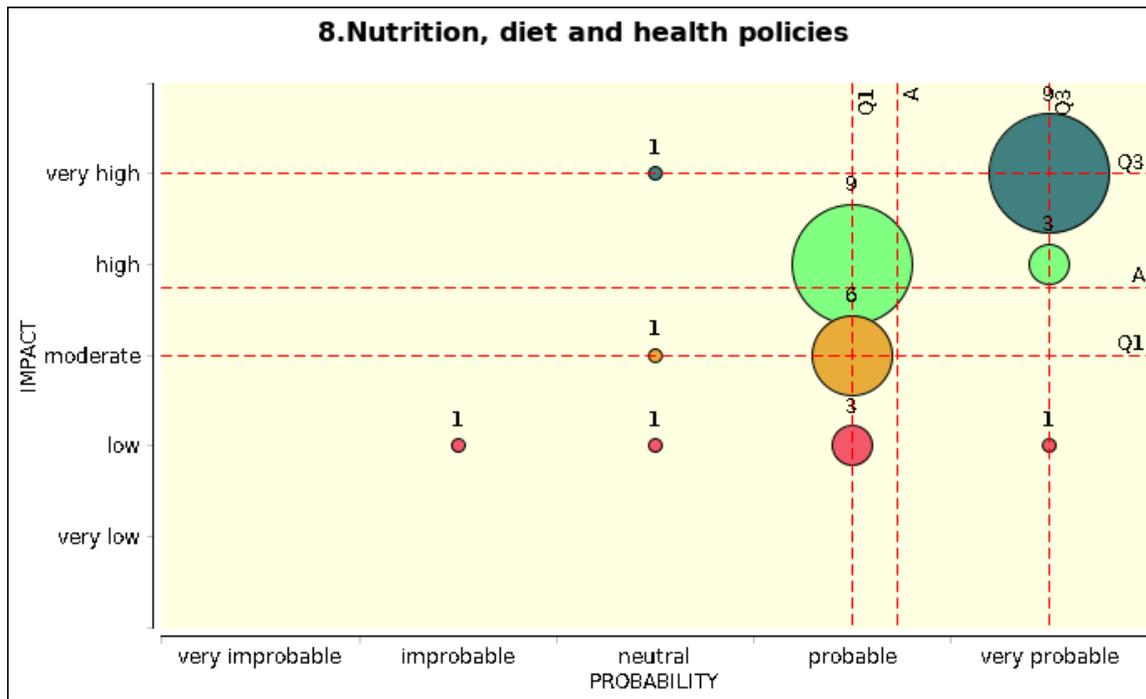


Most respondents agreed that at some point, launching climate measures will be inevitable and are likely to have a highly positive impact on legume-based food- and feed-chains. Such measures such as a carbon- or nitrogen-tax might be considered as an appropriate policy intervention and might receive support from the public, as there is a generally high awareness of climate change within society. On the other hand, climate measures can have a strong impact on current consumption patterns too (i.e. reducing meat consumption), where final outcomes are challenging to estimate due to complex interactions among several cultural, economic and political drivers. Additionally, current experience shows that the impact of climate measures often remains low due to their limited scale. Also, the current political climate (right-wing populism in many European countries) makes it questionable whether there is a real willingness of policymakers to make a paradigm shift.

- Suggested statement(s) for the second round of the Delphi: **Climate measures might effectively increase legume production and consumption if radical enough, and if built on public consensus that individual and collective actions need to be taken to mitigate and adapt to climate change. However, it is crucial to consider the complex interplay of economic, social and cultural factors to estimate the real impact of such interventions.**

**3.2.8. Nutrition, diet and health policies and public campaigns that promote the inclusion of legumes in the human diet make legumes more visible and also increase imports for consumption**

**Figure 13.**



	8. Nutrition, diet and health policies /PROBABILITY	8. Nutrition, diet and health policies /IMPACT
AV	1.23	0.74
SD	0.73	1.07

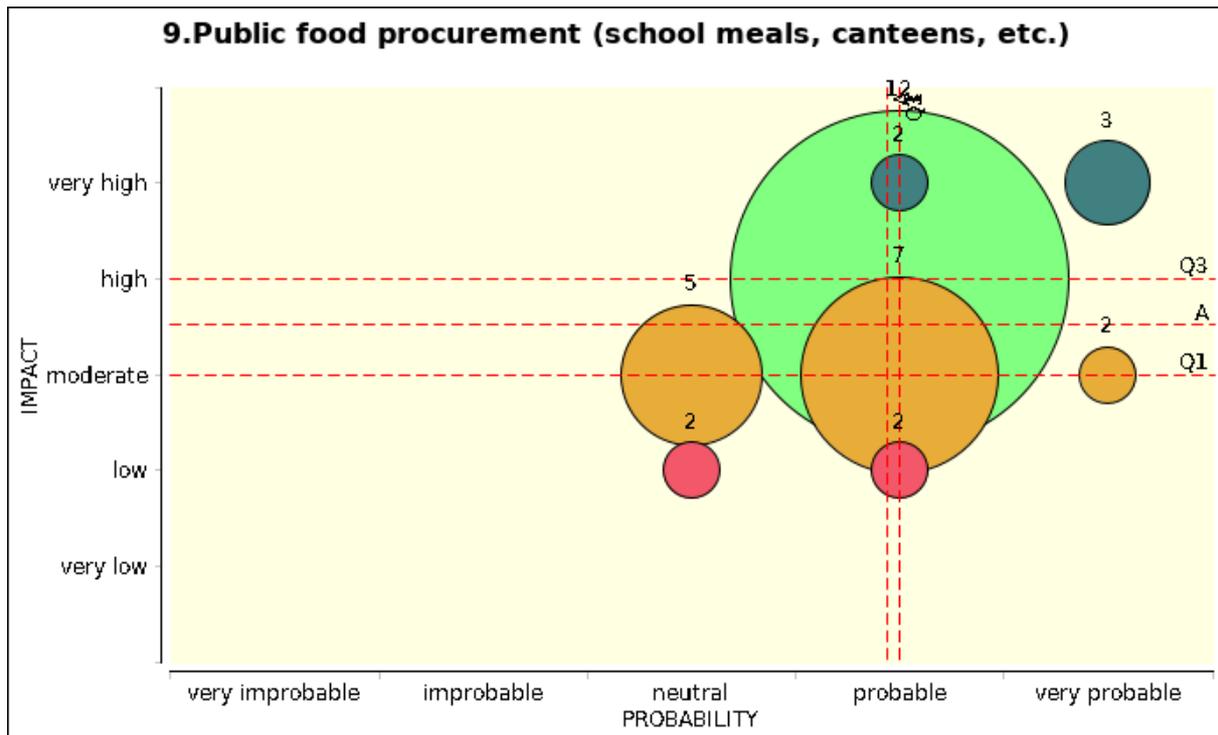


Nutrition, diet and health policies and campaigns were considered as very probable interventions that can have a high impact on legume consumption in Europe, and at the same time contribute to a more sustainable and climate-friendly (less meat-based) diet. Such interventions have already proved to be effective in some contexts, for example, one respondent mentioned the example from the Netherlands, where changing the weekly consumption advice in 2016 instantly resulted in better market availability and increased consumption of legumes. However, they do not address the issue of the relative competitiveness of European legume production (or import dependency) directly, even if the price of legumes for human consumption is usually higher than for animal feed. This could be guaranteed only if consumption focused measures are coupled with incentives for short food supply chains or domestic production. Additionally, the success of such interventions depends on several factors which are often difficult to control. For example, consumer information overload, tasty and easily digestible end products and general trust in policy guidance. Some respondents suggest that the actual campaign/policy design profoundly influences its success as, for instance, the failure of campaigns against obesity indicates. Therefore, messages should be carefully considered and focus on “topics people care about” (marketing legume-based food as meat replacement might “backfire”). If legumes are included in nutrition, diet and health policies, the diversity of leguminous plants and dishes should be promoted, and innovations in food technology should be taken up. Some respondents also warn that changing consumer behaviour is a slow process, and awareness-raising has limited impacts, especially if designed in a one-way communication format.

- Suggested statement(s) for the second round of the Delphi: **Nutrition, diet and health policies and campaigns can achieve the increased awareness and improved knowledge of consumers. Whether this can be turned into higher demand for domestically grown legumes, depends on the actual design of the policies and campaigns, the availability and attractiveness of leguminous food, and the policy support for short supply chains (domestic production).**

**3.2.9. Public food procurement offers more healthy options in foodservice markets that help the shifts towards legume-based diets**

**Figure 14.**



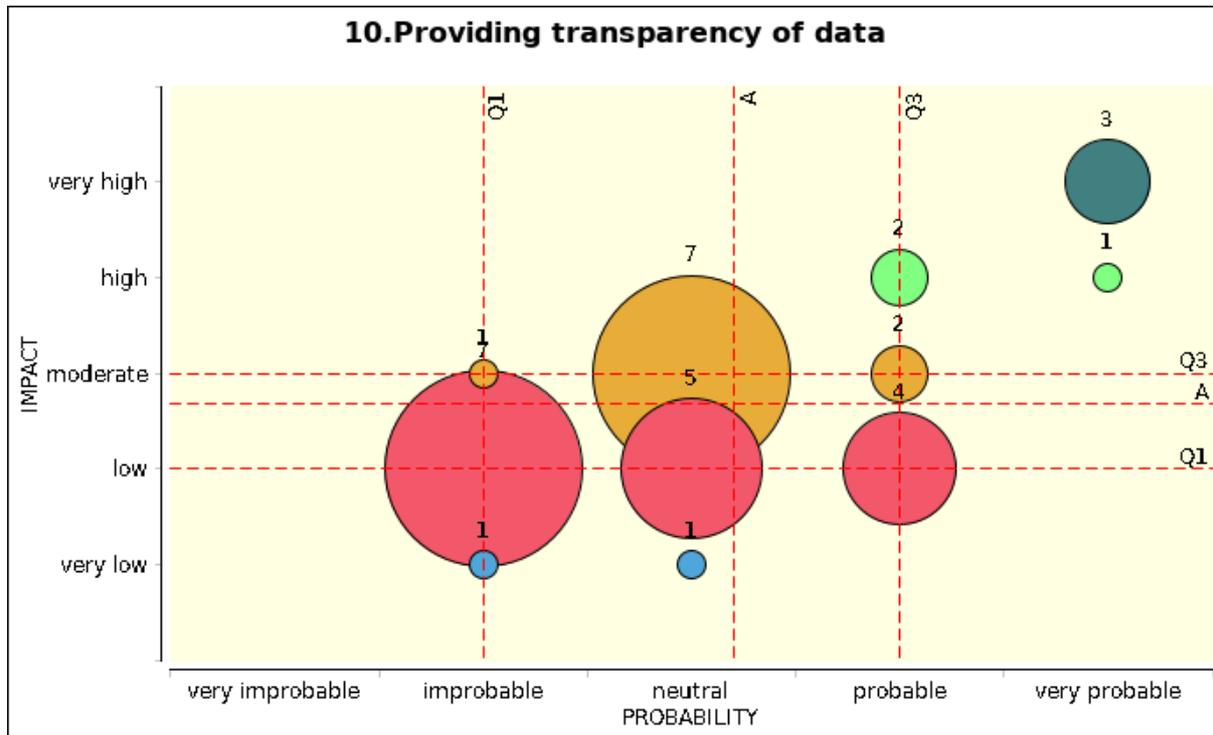
	9. Public food procurement (school meals, canteens, etc.)/PROBABILITY	9. Public food procurement (school meals, canteens, etc.)/IMPACT
AV	0.94	0.51
SD	0.59	0.89



Public food procurement was considered as an essential point for interventions, where a stronger focus on legumes was considered probable, and a policy that might have moderate to very high impact on legume production and consumption. It has a more direct influence on both the demand and the domestic supply of legumes than nutrition and health policies (c.f. section 2.8). It can indirectly influence consumer awareness and behaviour, especially if consumers are involved in preparing the meals, such as in school canteens (“*slow path to high impact*”). While respondents agree that realising the benefits of such an intervention takes time and might depend on cultural traditions, they also highlighted that several initiatives exist already at city or country level. Respondents also underlined that changing consumer behaviour is more natural at a younger age. Therefore, replacing animal protein with legumes to some extent might be more efficient in canteens, than via general nutritional guidelines. In order to make such interventions successful, it is important to create attractive leguminous food, for example: use traditional recipes where legumes are popular or create innovative bread spreads where there is a healthy bread eating culture. Also, and in similarity to nutrition and health policies, emphasis should be put on short supply chains to benefit domestic legume producers.

3.2.10. Providing transparency of market data help boost legume supply chains

Figure 15.



	10. Providing transparency of data /PROBABILITY	10. Providing transparency of data /IMPACT
AV	0.21	-0.32
SD	0.98	1.04



The transparency of market data proved to be one of the most ambiguous statements. Some respondents suggested that better information on market data could change power asymmetries within the supply chain, and therefore might help European producers to realise higher prices on the market. On the other hand, some respondents argued that most of the market information is already available, and it does not influence the relations along the supply chain much. As one participant stated: *“The feed industry will NOT pay extra for domestic protein over imported soy. The livestock sector will NOT pay extra for feed that is made from domestic protein instead of imported soy. Nevertheless, some consumers MAY pay extra for knowing that their meat is produced with domestic protein -- if that feeds back to the livestock farmer, the feed manufacturer and the protein-crop farmer, who knows.”* A small fraction believed that traders have no interest in making market data more transparent. Therefore, it is very unlikely to happen. However, many respondents stated that they did not see why market data should have any influence on the legume supply chain.



## 4. Conclusions from the TRUE-Legumes Delphi

In this Deliverable report, we described the technique and analysed the results of a policy Delphi that helped us to obtain expert opinion and agreement on the role of specific food policy domains to improve production and consumption of legumes. The food policy experts invited to this exercise assessed policies concerning their probability and impact.

This first round of the Delphi survey aimed at exploring the significant factors contributing to the relatively low production and consumption levels of legumes in Europe, and consequently outline the areas of potential policy interventions. This identified system lock-ins and barriers that hinder an increase in production and consumption of legumes. These barriers span across the entire value chain and are related to the economic effect of crop specialisation. Thus, it places cereal crops and livestock production at the forefront of technological innovation, R&D, and subsidies within European agriculture, leading to increasing returns to adoption. Thus, the environmental and health benefits of legumes are largely forfeited, underappreciated and poorly understood by farmers, policymakers and consumers.

Results of the first round of Delphi highlighted three major areas of possible policy intervention to unlock the legumes production system out of its stagnation.

1. The first action area is the substantial investment in R&D, improved access to extension services and regional networks and training facilities for farmers and producers. This action will support farmers' decision and will provide them with genetically improved varieties that are adapted to



climate shocks (i.e., drought) and are higher yielding. Experts have noted that professional advice to farmers may be of utmost importance in the initial stages of legumes inclusion in the farm cropping system. The knowledge transfer at this point can assure long-term farm production planning. This outcome is in line with previous findings of the TRUE policy analysis (Balázs et al., 2019). It implies a highly variable knowledge transfer across different European countries. In some contexts, public and private partnerships can boost knowledge co-creation and sharing, which eventually leads to an increased legume production (e.g. the German or the Italian policy case study in Balázs et al. (2019)). However, in several other countries, the farming sector lacks proper knowledge, varieties and technologies. Policies to enable investment in research and development should have a geographical focus when upscaling the existing best practices of innovation and knowledge transfer.

2. The second area of action is that of policies in support of the environmental benefits (biological nitrogen fixation, increased biodiversity, combating soil degradation) and farm-economic value of legumes (reduced inorganic nitrogen fertiliser inputs for the subsequent crop in the rotation, and reduced use of pesticides). The greening payments and the Ecological Focus Areas already existing within the CAP can be strengthened by including benefits that pertain to legumes, thus incentivising sustainable farming. In this respect, climate change mitigation policies such as the introduction of carbon- and inorganic nitrogen fertiliser-taxes, or incentives to reduce the use of inorganic nitrogenous fertiliser, such as via CAP and trade measures, could support sustainable agriculture and thus incentivise the increased cultivation of legumes. In terms of feasibility, a critical challenge for such policy innovations is the monitoring and sanctioning of non-compliance. Results-based schemes have already been in place to overcome such



difficulties. In order to improve compliance, better information and guidance should be provided to farmers through extension services, instead of stricter sanctions. Similarly, until farmers' adoption of legume crops is dependent on policies focussing on nitrogen fixation, forage legumes are a logical choice, but will not lead to increased production of legumes for human consumption.

- 3.** The third area of action pertains to the demand side. It is necessary to connect food choices with their health and environmental impact. Therefore, dietary guidelines, public procurement programmes, plus awareness and educational campaigns should focus on these two aspects together, not as separate entities. Consumers in the EU have become more conscious of the environmental impacts of agriculture, but currently, they pay a premium price for the positive externalities. Instead, taxing negative externalities not only benefits the environment and health, but it is also competitive in the market.
- 4.** A core message of the first round of the Delphi is that there is no silver bullet. We have not identified one single policy area where interventions could push the legume value chain into more sustainable directions. This leads us to the idea of policy mixes, i.e. multiple changes in the policy landscape, which, through interaction, are predicted to have a considerable impact on both the production and the consumption of legumes in Europe.

Taking this idea forward, we intend to focus the next round of our Delphi study on the following four main lines of inquiry.



## 1. POLICY MIXES - What policies would help? Which instruments are needed?

Based on the first round of the Delphi, we have identified the three most relevant policy areas: 1, support research and development; 2, ban and/or limit the use of inorganic nitrogen fertilisers, or support the use of legumes for their benefits of biological nitrogen fixation; 3, promote legume consumption in health and nutrient policies. It is also possible to extract several of the more promising and innovative policy instruments from the Delphi narratives to enable respondents to create their own “policy mixes” in the second round of the Delphi.

Some essential elements of the policy mixes:

**Increasing environmental, ethical and safety standards for imported raw protein sources** (used either for feed or food) closes the profitability gap between imported and homegrown legumes.

**Applying stricter environmental and climate regulations** (e.g. carbon tax and/or the soil directive) for crop- and livestock-production in Europe can ensure that agricultural policies targeting the homegrown production of protein crops (i.e. protein strategies) avoid unintended adverse impacts on the sustainability of European livestock production.

**Focusing research and development on more effective crop rotation schemes**, and options to better recycle nitrogen, opens a policy window to launch reward systems - which if accompanied with farm advisory/extension services for farmers, will encourage reduced inorganic fertiliser use by increasing legume production.

**Climate measures might effectively increase legume production and consumption** if radical enough, and if built on public consensus that individual and collective actions need to be taken to mitigate and adapt to climate change. However, it is crucial to consider the complex interplay of economic, social and cultural factors to estimate the real impact of such interventions.

**Nutrition, diet and health policies and campaigns** can achieve increased awareness and improved knowledge of consumers. Whether this can be turned into higher demand for domestically grown legumes, depends on the actual design of the policies and campaigns, the availability and attractiveness of leguminous food, and the policy support for short supply chains (domestic production).



- 2. ELIMINATE CAP - What if in Europe we eliminate the subsidies to agriculture and use tax-payers' money to fund extensive public agronomic R&D as in Canada and Australia? What would you expect?**

Based on the first round of the Delphi, we will extract promising and surprising narratives on knowledge transfer, technical advisory systems, support investment in technology, storage, processing to enable respondents envisioning a radical abandonment of productivist agriculture subsidies.

- 3. ROLE OF PUBLIC INSTITUTIONS - Who should be in charge? Who can act to change current policies and create room for those policy instruments that you included in your "Policy mix"?**

Based on the first round of the Delphi, we will ask stakeholders to assess the role of public institutions in inducing systemic change.

- 4. MOVE OUT OF THE BOX - Can you think of the consequences beyond legumes? Should we instead invest in R&D on insect-based proteins or even synthetic meats, for example? That is, largely dissociate protein production from land-use.**

Based on the first round of the Delphi, we will ask stakeholders to envision completely out of the box solutions such as dissociating protein production from land use and benefits of legumes.

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## Annex I. Invitation of experts

Dear Expert,

**Why are legume cultivation and consumption so low in Europe? What would lead to more legumes in our food system? What are the most effective policy mixes to forge pathways towards legume-based food systems?**

ESSRG and the TRUE project invites you to contribute your views to a Delphi study on how to advance the legumes role in our food system. We believe that we need to develop favourable governance contexts of legumes as legumes are essential to a sustainable diet, essential for healthy ecosystems and agriculture and a straightforward choice in food systems to avoid climate and extinction crisis. Therefore legume-based food systems are essential to cater to a growing demand for plant protein-based food - processed or raw. Recent trends reflect newly emerging opportunities for improving legumes and novel pulse products role in ecosystem-friendly production and healthy consumption. However, unprecedented global challenges also threaten to block the progress towards these aims. Therefore, research on legumes must draw on a variety of future perspectives from many different stakeholders and knowledge domains to point out solutions towards better and more legumes in our food system.

Your valuable perspective and unique contribution to this Delphi panel are essential for us to create evidence-based and plausible pathways towards legume-based food systems.

The Delphi study about the favourable governance contexts of legumes proceeds in three rounds, and you will have the chance to learn the insightful and thought-provoking but anonymous responses of other participants. Your responses also remain anonymous. Anonymised information will be shared with the Delphi panel members and later collated into reports, journal articles, book chapters, presentations about legume pathways.

We trust that you find the exercise rewarding and encourage you to invite any of your interested colleagues by forwarding this invitation. Responding to the questionnaire takes approximately 15 minutes. The Delphi questionnaire consists of policy statements that reflect some policy prospects for legumes. You will be asked to evaluate and comment on these statements.



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## Annex II. Background to the TRUE project

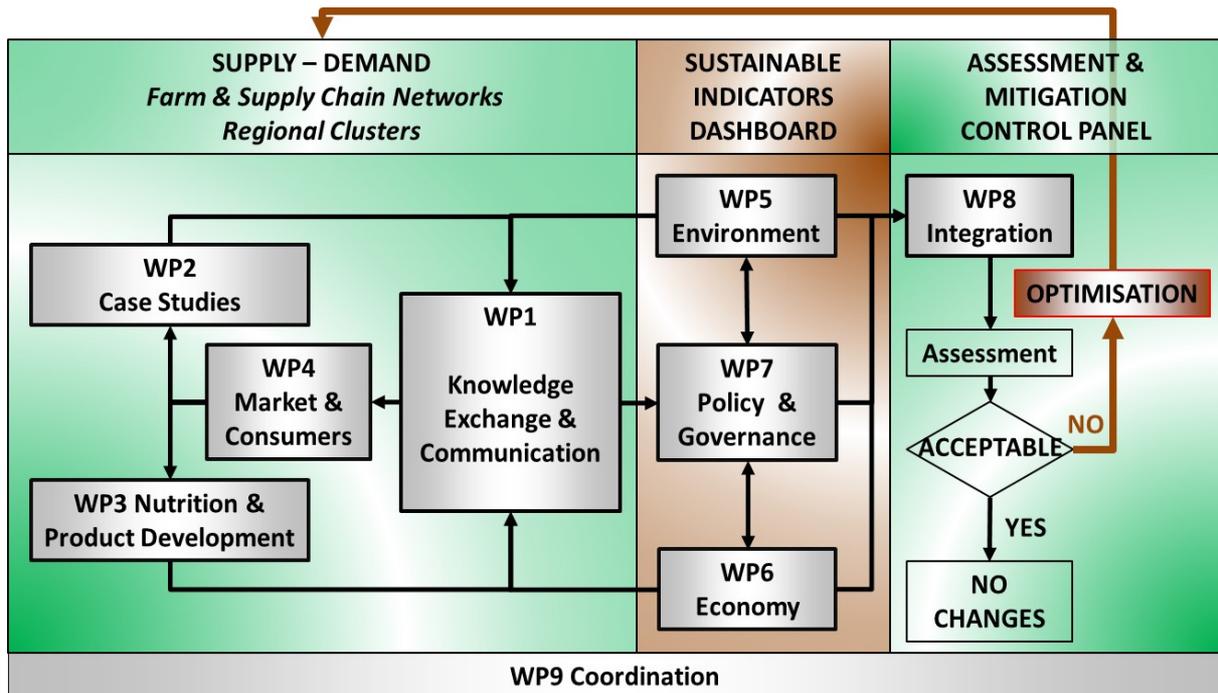
### Executive Summary - abbreviated

TRUE's perspective is that the scientific knowledge, capacities and societal desire for legume supported systems exist, but that practical co-innovation to realise transition paths have yet to be achieved. TRUE presents 9 Work Packages (WPs), supported by a *Intercontinental Scientific Advisory Board*. Collectively, these elements present a strategic and gender-balanced work-plan through which the role of legumes in determining 'three pillars of sustainability' – 'environment', 'economics' and 'society' – may be best resolved.

TRUE realises a genuine multi-actor approach, the basis for which are three *Regional Clusters* managed by WP1 ('*Knowledge Exchange and Communication*', University of Hohenheim, Germany), that span the main pedo-climatic regions of Europe, designated here as *Continental*, *Mediterranean* and *Atlantic*, and facilitate the alignment of stakeholders' knowledge across a suite of 24 Case Studies. The Case Studies are managed by partners within WPs 2-4 comprising '*Case Studies*' (incorporating the project database and *Data Management Plan*), '*Nutrition and Product Development*', and '*Markets and Consumers*'. These are led by the Agricultural University of Athens (Greece), Universidade Catolica Portuguesa (Portugal) and the Institute for Food Studies & Agro-Industrial Development (Denmark), respectively. This combination of reflective dialogue (WP1), and novel legume-based approaches (WP2-4) will supply hitherto unparalleled datasets for the '*sustainability WPs*', WPs 5-7 for '*Environment*', '*Economics*' and '*Policy and Governance*'. These are led by greenhouse gas specialists at Trinity College Dublin (Ireland; in close partnership with Life Cycle Analysis specialists at Bangor University, UK), Scotland's Rural College (in close partnership with University of Hohenheim), and the Environmental and Social Science Research Group (Hungary), in association with Coventry University, UK, respectively. These *Pillar WPs* use progressive statistical, mathematical and policy modelling approaches to characterise current legume supported systems and identify those management strategies which may achieve sustainable states. A *key feature* is that TRUE will identify key *Sustainable Development Indicators* (SDIs) for legume-supported systems, and thresholds (or goals) to which each SDI should aim. Data from the *foundation WPs* (1-4), to and between the *Pillar WPs* (5-7), will be resolved by WP8, '*Transition Design*', using machine-learning approaches (e.g. *Knowledge Discovery in Databases*), allied with *DEX* (*Decision Expert*) methodology to enable the mapping of existing knowledge and experiences. Co-ordination is managed by a team of highly experienced senior staff and project managers based in The Agroecology Group, a Sub-group of Ecological Sciences within The James Hutton Institute.

### Work-package structure - diagram

The flow of information and knowledge in TRUE, from the definition of the 24 case studies (left), quantification of sustainability (centre) and synthesis and decision support (right).



### Project partners - table

No	Participant organisation name (and acronym)	Country	Organisation Type
1 (C*)	The James Hutton Institute (JHI)	UK	RTO
2	Coventry University (CU)	UK	University
3	Stockbridge Technology Centre (STC)	UK	SME
4	Scotland's Rural College (SRUC)	UK	HEI
5	Kenya Forestry Research Institute (KEFRI)	Kenya	RTO
6	Universidade Catolica Portuguesa (UCP)	Portugal	University
7	Universitaet Hohenheim (UHOH)	Germany	University
8	Agricultural University of Athens (AUA)	Greece	University
9	IFAU APS (IFAU)	Denmark	SME
10	Regionalna Razvojna Agencija Medimurje (REDEA)	Croatia	Development Agency
11	Bangor University (BU)	UK	University
12	Trinity College Dublin (TCD)	Ireland	University
13	Processors and Growers Research Organisation (PGRO)	UK	SME
14	Institut Jozef Stefan (JSI)	Slovenia	HEI
15	IGV Institut Fur Getreideverarbeitung Gmbh (IGV)	Germany	Commercial SME
16	ESSRG Kft (ESSRG)	Hungary	SME
17	Agri Kulti Kft (AK)	Hungary	SME
18	Alfred-Wegener-Institut (AWI)	Germany	RTO
19	Slow Food Deutschland e.V. (SF)	Germany	Social Enterprise
20	Arbikie Distilling Ltd (ADL)	UK	SME
21	Agriculture And Food Development Authority (TEAG)	Ireland	RTO
22	Sociedade Agrícola do Freixo do Meio, Lda (FDM)	Portugal	SME
23	Eurest -Sociedade Europeia De Restaurantes Lda (EUR)	Portugal	Commercial Enterprise
24	Solintagro SL (SOL)	Spain	SME
25	Public Institution Development of the Medimurje County	Croatia	Development Agency

\*Coordinating institution



## Objectives - abbreviated

### **Objective 1: Facilitate knowledge exchange (UHOH, WP1)**

- *Develop a blueprint for co-production of knowledge*

### **Objective 2: Identify factors that contribute to successful transitions (AUA, WP2)**

- *Relevant and meaningful Sustainable Development Indicators (SDIs)*

### **Objective 3: Develop novel food and non-food uses (UCP, WP3)**

- *Develop appropriate food and feed products for regions/cropping systems*

### **Objective 4: Investigate international markets and trade (IFAU, WP4)**

- *Publish guidelines of legume consumption for employment and economic growth*
- *EU infrastructure-map for processing and trading*

### **Objective 5: Inventory data on the environmental intensity of production (TCD, WP5)**

- *Life Cycle Analyses (LCA) -novel legumes rotations and diet change*

### **Objective 6: Economic performance - different cropping systems (SRUC & UHOH, WP6)**

- *Accounting yield and price risks of legume-based cropping systems*

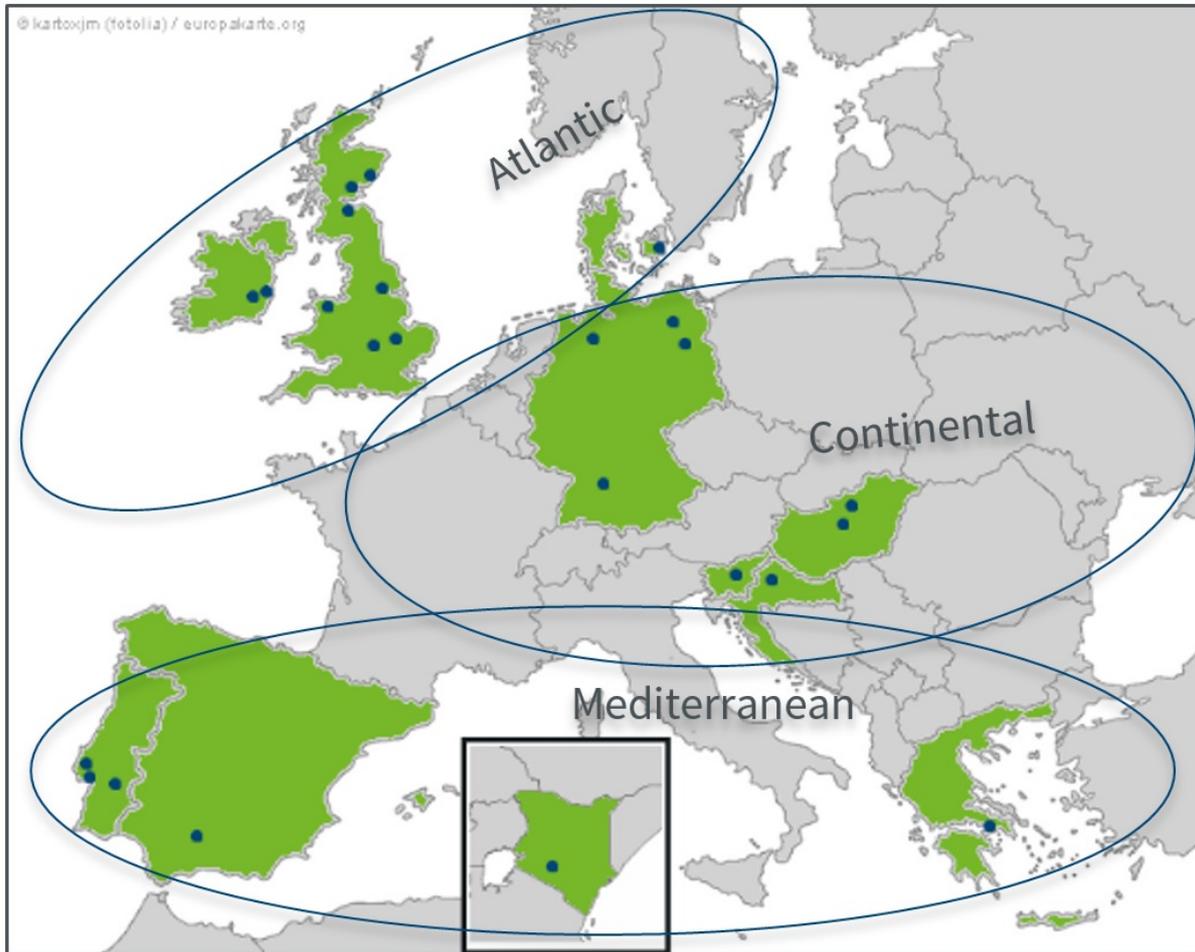
### **Objective 7: Enable policies, legislation and regulatory systems (ESSRG, WP7)**

- *EU-policy linkages (on nutrition) to inform product development/uptake*

### **Objective 8: Develop decision support tools: growers to policymakers (JSI, WP8)**

- *User-friendly decision support tools to harmonise sustainability pillars*
-

### Legume Innovation Networks – diagram



Knowledge Exchange and Communication (WP1) events include three TRUE European Legume Innovation Networks (E-LINs), and these engage multi-stakeholders in a series of focused workshops. The E-LINs span three major pedoclimatic regions of Europe illustrated above within the ellipsoids for Continental, Mediterranean and Atlantic zones.



## Disclaimer

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## Citation

Please cite this report as follows: Balázs, B., Kelemen, E., Centofanti, T., Vasconcelos, M., Maaß, H., Kolmans, A., Squire, G., Tran, F., Bienkowski, D., Iannetta, P.P.M. (2019). Application of Delphi for governance contexts which favour legume-supported value chains: D7.3 (D42) for the EU-H2020 project, 'TRansition paths to sUustainable legume-based systems in Europe' (TRUE), funded under Grant Agreement Number 727973. DOI: 10.5281/zenodo.3585198.

Available online at: [www.true-project.eu](http://www.true-project.eu).