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Policy Interventions Promoting Sustainable Food- and Feed-Systems: A Delphi Study of Legume Production and Consumption

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Citation: Balázs, B.; Kelemen, E.; Centofanti, T.; Vasconcelos, M.W.; Iannetta, P.P.M. Policy Interventions Promoting Sustainable Food- and Feed-Systems: A Delphi Study of Legume Production and Consumption. *Sustainability* **2021**, *13*, 7597. https://doi.org/10.3390/su13147597

Academic Editors: Adanella Rossi, Anna Irene De Luca and Giaime Berti

Received: 26 March 2021
Accepted: 30 June 2021
Published: 7 July 2021

Abstract: The food- and feed-value systems in the European Union are not protein self-sufficient. Despite the potential of legume-supported production systems to reduce the externalities caused by current cultivation practices (excessive use of N fertilizer) and improve the sustainability of the arable cropping systems and the quality of human diets, sufficient production of high-protein legume grains in Europe has not been achieved due to multiple barriers. Identifying the barriers to the production and consumption of legumes is the first step in realizing new pathways towards more sustainable food systems of which legumes are integral part. In this study, we engage stakeholders and decision-makers in a structured communication process, the Delphi method, to identify policy interventions leveraging barriers that hinder the production and consumption of legumes in the EU. This study is one of a kind and uses a systematic method to reach a common understanding of the policy incoherencies across sectors. Through this method we identify policy interventions that may promote the production of legumes and the creation of legume-based products in the EU. Policies that encourage reduced use of inorganic N fertilizer represent an important step toward a shift in the increased cultivation of legumes. Relatedly, investment in R&D, extension services, and knowledge transfer is necessary to support a smooth transition from the heavy use of synthetic N fertilizer in conventional agriculture. These policy interventions are discussed within current EU and national plant-protein strategies.

Keywords: sustainable food systems; policy analysis; legumes

1. Introduction

Legume-supported value chains, from production to consumption, provide evidence-based advantages that include improved ecosystem functions and resource use efficiency, as well as farmed animal and human health provisions. Environmental co-benefits of legumes include reduced nitrate leaching, increased food sources for pollinators, a greater structural diversity of farmland, and improved soil fertility [1,2]. Despite the potential of legumes to improve the sustainability of arable cropping systems and enhance the quality of farmed animal and human diets, the production and consumption of legumes in Europe is low, and their demand as feed is high, which is the adaptation of a phenomenon termed "the legume paradox" [3].

Multiple barriers limit the production, processing, marketing, and consumption of legumes in Europe, which are caused by various forms of system lock-ins and capacity gaps that span multiple levels of the food system. These system lock-ins have been analyzed extensively, and the low production and consumption have been attributed to many factors, such as (a) insufficient understanding and appreciation of non-marketed products and services of legumes by farmers, (b) agri-environmental regulations and public or private payments that only partly address the negative externalities produced by market failure of crop specialization, (c) lower yields and yield instability of legumes causing low profitability compared to other major non-legume crops, (d) reduced access to sufficient and publicly-funded independent agricultural extension or advisory services skilled in legume-supported crop system management, (e) lack of capacities for aggregation and post-harvest storage and processing, and (f) limitations in the categorization of legumes (in wholesalers) [3–6].

Identifying the barriers to the production and consumption of legumes locally is the first step to creating new pathways towards realizing legume-supported food systems in practice and accomplishing their associated benefits, too. Policies that attempt to favor legume-supported value chains are often inconsistent, as they conflict with a complex set of social, structural, market, and behavioral factors and capacities that influence stakeholders' perceptions and decisions. Furthermore, policies to increase more sustainable legume-supported production are not allied with a single coherent sustainable-food policy, since the latter is lacking from the EU policy portfolio, and the food policy domain is scattered and disintegrated. Policies that impact legume-supported systems operate across multiple governance levels shaped by international, EU, national, and regional agreements. The result is a conflicting policy framework: Some seek to diminish the environmental footprint of agriculture; others incentivize the agri-business strategies that are not in line with sustainable food systems [4,7,8] or healthy diets [7].

To reduce reliance on imported protein and dependence on supply and market volatility, few countries in Europe (i.e., Germany, France, Denmark, Finland, and the Netherlands) have implemented national protein strategies to increase domestic protein production, and particularly for the large high-protein legume grains. Cultivated areas used to produce large-grain legumes have increased over the past 10 years because of numerous instruments based mainly on the foundation of financial incentives and specifically agricultural subsidies, most commonly derived from the most recent reform of the Common Agricultural Policy (CAP) in 2013 plus other national and regional funds. Income support payments to EU farmers are dependent on their "cross-compliance" with certain obligations. For example, the 2013 CAP reform determined 30% of Pillar 1′s "direct payments" as "greening" measures, including the option to cultivate grain legumes in Ecological Focus Areas (EFA) on at least 5% of each farm's arable land. Nearly 40% of the total EFA land area has been planted with nitrogen (N)-fixing crops. Out of the 12 EU member states (MS) that produce soya, 10 made this crop eligible for planting in EFAs. This led to the EU having not just 5% of arable land in EFA, as regulations require, but 15%. As such, the main driver for the increased production of high-protein legume grains in the EU is the subsidy for EFA without incentivizing those legumes with more sustainable value chains. Consequently, the introduction of a ban on the use of pesticides for N-fixing crops in the EFA is now slowing and reversing the positive progression of legume-protein production across the EU [8]. It may be argued that the policy goal should not be to invest public money in the production of legumes, but rather to create enabling conditions for the farming, processing, and consuming of legumes, which in turn can imply an increase in the sustainably managed agricultural area.

This leads us to question: How can the CAP, Supranational Protein Strategies [9], and the EU Farm to Fork Strategy within the European Green Deal [10] be integrated to address the "policy paradoxes" and deliver a more effective "policy toolbox" that is capable of sustaining increased grain legume production and consumption across Europe? Any improved suite of interventions should sustain legume grain production even when subsidies are removed and ensure sufficient market "pull" while overcoming any perceptions that reduced mineral N fertilizer use is linked to lower yields. Coherent policies in support of legume-supported cropped systems and the delivery of sustainable and healthy feed and food can be better designed when the stakeholders and decision-makers are engaged in the development of policies and governance frameworks [11,12].

Towards identifying this more resilient policy mix capable of overcoming the barriers hindering the production and consumption of legumes in the EU, we engaged a broad range of stakeholders and decision-makers using a systematic communication approach, the "Delphi method" [13,14], which facilitates the exchange of informed opinions on the legume paradox. In this process, we first reach a common understanding of the policy incoherencies across sectors and focus efforts towards identifying the suite of policy recommendations that may realize sustainable legume-supported food and feed systems more effectively across the value chain from production to consumption.

2. Materials and Methods

2.1. The Delphi Method

Expert-based future methods systematically investigate and develop policies regarding complex problems via the stimulation and informing of public dialogues. Policymakers can benefit from such strategic foresight in three main ways, according to the Organisation for Economic Co-operation and Development (OECD): (1) better anticipation, to identify and prepare sooner for new opportunities and challenges that could emerge in the future; (2) policy innovation, to spur new thinking about the best policies to address these opportunities and challenges; and (3) futureproofing, to stress-test existing or proposed strategies against a range of future scenarios. It is helpful especially in times of uncertainty when multiple future possibilities emerge, and the predictive capacities are limited [15].

Several other foresight methods are used in food policy and governance studies to create pathways to sustainability transformations. Delphi studies are often implemented in multimethod settings, in combination with multiple other foresight methods, such as horizon scanning, road mapping, visioning, multi-criteria analysis, stakeholder mapping, scenarios, participatory planning, back-casting, and serious gaming [16]. Foresight for food system transformations often requires multi-actor settings. Based on insights from the four case studies of the TRANSMANGO project, Hebinck et al. [17] argued that such collaborative spaces are prefigurative. That is, such foresight initiatives not only conceptualize, but even initiate transformative change by conceptualizing the needed change, creating new actor networks, and generating high-chance implementation strategies. In another setting, several pathways towards a sustainable food system in Kyoto in Japan have been designed by applying the combination of visioning, back-casting, and simulation games that altogether stimulate learning about new food-system practices [18]. In addition, new modes of governance, components, and resources for degrowth (moving away from implementation models that place economic growth as a central tenant of sustainable development) for food systems have been explored, for example, by the Budapest City Lab via visioning workshops with the actors of the local food system [19].

Delphi as a semi-quantitative, interactive foresight method gained popularity over the last 20 years for deployment in multiple settings with aims that ranged from exploratory studies to policy recommendations, from anticipating possible futures to suggesting desirable ones [20]. Delphi is typically preferred when the skill and knowledge of individuals in a particular area or subject need to be mobilized via an expert panel around a specific policy problem(s). The "legume paradox" offered such a scenario and helped identify policy recommendations for legume-based food systems. The Delphi method, as developed by Rand Corporation futurologists Norman Dalkey and Olaf Helmer, is considered an expert (tacit and explicit) knowledge aggregation procedure that can help planners and decision-makers inform pragmatic choices regarding possible futures [21]. The Delphi method was 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, [22]). 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, and uses the mechanism of the exercise as a filter to preserve the anonymity of responses (p. 19, [23]).

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 for a quick compromise. The main benefit of Delphi, as Rikkonen et al. [24] contended, is that it enables relatively quick consensus for solution-seeking. Furthermore, it provides practical descriptions for future decisions, and it is in this sense that it can act as a decision-support tool. Delphi's structured process means that experts are invited into a communicative learning process that enables opinion formation via an anonymous space for feedback and dialogue. Thus, Delphi can reduce pressure on free interaction by dominant individuals or to conform to the majority view [25].

A particular type of Delphi explores and develops dialogues for policy development. The "policy Delphi," according to Rayens and Hahn [14], is a systematic method for obtaining, exchanging, and developing an informed opinion on a policy issue or any institutional problem—such as the legume paradox or puzzle [3], and the arguments around its possible solutions. Raynes and Hahn [14] further emphasized the consensus-seeking aspect of this process for or against policy issues, whereas de Loe [26] outlined that it creates opportunities for future policy decisions. Authors in the published literature differentiated four main types of policy Delphi. In an "Argumentative Delphi" [27], the outcomes are consensual, evidence-based arguments. Thus, Argumentative Delphi can help policymaking, as panel members are known to each other and researcher-facilitators directly generate debate about the conflicting points. In contrast, a "Disaggregative Delphi" [15] provides the clustering of diverse opinions, and researchers attempt to outline various scenarios. In a "Trend Modelling Delphi," experts assess current trends, whereas in a "Structural Modelling Delphi," they assess causal linkages to create a new conceptual models of the issues. In sum, the main advantages of the Delphi, according to Landeta [28], are as follows: Social dominance is avoided, as high-status advocates cannot shape opinions—therefore, a plurality of viewpoints emerge; feedback loops enable a learning journey for participants; and some mathematical–statistical methods can be used in aggregating opinions. The main challenges of a Delphi are subjectivity, as it often reflects the subjective views of the summarizing experts; confirmation bias, i.e., a tendency to select the arguments according to summarizing experts' preconceptions; and interest, since general researchers' interests might be overrepresented compared to other stakeholders [15,16,29].

We chose the eDelphi open-source software (Metodix Ltd, Helsinki, Finland) to send out invitations by email. To reach a balanced composition of the invited experts, beyond our previous professional contacts, stakeholders from regional Legume Innovation Network (LIN) workshops organized within the EU-funded H2020 project TRUE and corresponding authors from the relevant literature on legumes were invited to join the panel. Eighty experts representing various sectors such as research, policy, advocacy, food processing, seed supply/crop breeding, and agronomist/agricultural extension services agreed to participate. Thirty-three (Round 1) and 43 (Round 2) experts finally participated in the Delphi. We gathered basic demographics (gender, age, sector, and education) of the participant experts in Round 1 and 33 participants provided their data. Our panel participants were predominantly 35–65-year-old male researchers with a doctoral degree [30].

The primary goals of this Delphi study were to:

1. Enable contributions of opinions from a panel of geographically dispersed policy experts and stakeholders;
2. Reach a common understanding of the legume policy incoherencies across sectors; and
3. Help opinion formation to identify policy instruments to leverage barriers for legume production and consumption.

This Delphi was conducted in two rounds. Round 1 mainly focused on identifying the significant factors contributing to the relatively low production and consumption of legumes in Europe. Round 2 primarily focused on outlining the potential target areas of policy scenarios, where future actions could support legume production and consumption.

2.1.1. Round 1

In Round 1, participants were asked the following questions.

(a) What are the policy challenges to increase domestic legume production and consumption?
(b) Why are legume cultivation and consumption rates relatively low in Europe?
(c) Which policies would lead to more legumes in our food system?
(d) What are the most effective policy mixes to forge pathways towards legume-supported food and feed systems?

After this set of questions, participants were asked to assess 10 statements (Table 1) outlining different policy interventions, which were identified based on literature review, document analysis, and case studies as reported by Balázs et al. [31]. The assessment looked at two aspects: the probability that a specific policy intervention leads to changes in legume production and consumption, and the impact that a specific policy intervention could have on legume production and consumption. Probability was ranked from 1 to 5, where 1 = very low probability, 2 = low probability, 3 = moderate probability, 4 = high probability, and 5 = very high probability. Impact was ranked from 1 to 5 on the same 1 = very low to 5 = very high impact scale. Participants had the option of including comments after each statement to explain the reasons for their assessment. After submitting their assessments and comments, other participants' responses were made visible so that the participant could choose to modify their answers if needed. It must be noted that various participants rated the impact only against legume production and not consumption, because for some participants (about 15%), these two aspects should have been assessed separately.

Table 1. Description of statements outlining different policy interventions that affect legume production and consumption in Europe. The codes that identify each intervention were used in Figures 1 and 2.

Statement Number and Code	Statement Description
1 (T)	Changing international trade agreements would reduce the EU's dependency on non-taxable soybean imports.
2 (CI)	Agricultural incentives within the CAP support cultivation of legumes.
3 (CG)	Green direct payments of the CAP foster the transition to sustainable food and feed systems.
4 (PS)	Policies supporting legume production and consumption increase industrialized livestock production as well.
5 (IRD)	Investments in agri-food and -feed research and knowledge transfer increase the competitiveness of protein crops and legume-supported food products.
6 (NFU)	Preventing the use of inorganic N fertilizers creates room for more legume production.
7 (CCP)	Climate change policies may influence the reduction of meat production and consumption; they also increase legume cropping and decrease the use of inorganic fertilizer.
8 (DH)	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.
9 (PFP)	Public food procurement strategies that focus on sustainability offer healthier options in foodservice markets that trigger shifts towards legume-supported diets.
10 (TD)	Providing transparency of market data boosts legume value chains.

2.1.2. Round 2

In Round 2, participants were asked to assess the impact of seven policy scenarios (that included different measures and instruments derived from Round 1) that could impact (1) legume production and consumption, and (2) the sustainability of EU agriculture. The seven policy scenarios were extracted from Round 1 as the most relevant interventions, ranging from broad policy changes to more specific and targeted measures and instruments. Impact was assessed on a 7-point scale, where 1 = strongly not impactful, 2 = not impactful, 3 = somewhat not impactful, 4 = neutral, 5 = somewhat impactful, 6 = impactful, and 7 = strongly impactful. Participants were given the option to add comments after assessing each policy scenario. After the individual assessment, they were asked to select three of the seven scenarios they considered the most important to forge pathways toward legume-supported sustainable food and feed systems in Europe. The seven proposed policy scenarios are defined below.

(1) Legal measures to reduce the use of synthetic N fertilizer use (i.e., allowances for farmers).
(2) Increased environmental, safety, and ethical standards for imported raw protein sources.
(3) Funds for public–private extension plus research and development (R&D) services supporting legume-supported cropping systems.
(4) Support for investments in technology (including breeding and agrotechnology), storage, and processing.
(5) Climate measures related to food consumption e.g., tax on meat, ban on red meat.
(6) Dietary guidelines and healthcare recommendations on why and how to shift to a (more) plant-based diet.
(7) Elimination of the CAP.

In addition, participants were asked to answer the following questions.

(1) How fast do you expect the proposed policy instruments to be implemented?
(2) Is it an incremental policy change, or rather a radical shift in policy that could lead to the implementation of the policy instruments you envisaged?
(3) What could be the role of various institutions (public and state institutions, large and small business, and bottom-up civic initiatives) to induce policy change?

2.2. Data Analysis

Data were analyzed using Gretl [31] and QDA miner 4 lite (Provalis Research, Montreal, QC, Canada). Descriptive statistical analyses were undertaken that included measures of means, medians, and quartile and interquartile ranges. This provided a first indication of the consensus or disagreement amongst participants. The greater the interquartile range, the greater the degree of dispersion from the central point of the trend in the group's response (median). Narrative answers (the textual comments) were coded using 40 in vivo codes in the first round and 51 in vivo codes in the second round. In vivo codes in the first round were grouped into six categories and mapped into a basic mental model showing logical links between the different categories. The six categories were enriched, cross-checked, and refined in the second round (see Appendices A and B for a detailed explanation). The six categories that finally emerged were (1) economics, (2) social, (3) environmental, (4) policies, (5) technology, and (6) farming.

In the economics category we had one sub-category ("economic/business") that included two codes (trade and marketing). Other codes included in the economics category were incentives, competition, value chain, demand, investment, and costs. In "social" there were nine codes: cultural barriers, tradition, values, preferences, complexity, health, consumption, education, and activism.

In the environmental category the six codes were sustainability, carbon sequestration, biodiversity, externalities, integrated/diversified farming, and greening measures; it also included one sub-category ("environmental/externalities"), which consisted of the following codes: climate change, pollution, fertilizer, and pesticides.

In the policies category, there were six codes and one sub-category with three codes. The six codes were subsidies, policy reforms, bans, regulatory policies, inertia, and supportive. The three codes for the sub-category "policies/bottlenecks" were systems lock-ins, risks, and bottlenecks.

In the technology/innovation category the five codes were processing, agricultural extension services, research, breeding, innovation, and knowledge. In the farming category, there were eight codes: production, crops/arable area, meat/dairy, smallholder/small scale, nutrition, good agricultural practices, rotations, and pest resistance. The codes were used to categorize the text of the comments and to quantify the codes that occurred most often in the comments for each scenario in Round 2.

3. Results

3.1. Round 1

Three policy interventions were ranked as most impactful and probable: (1) investments in research, development, and knowledge transfer (IRD); (2) restrictions on synthetic N fertilizer use (NFU); and (3) nutrition, diet, and health policies (DH). The results of the impact and probability assessment of all 10 statements are shown in Figures 1 and 2, and the qualitative analysis summary is shown in Figure 3.

The impact mean value of these policy interventions was around level 4, and IRD received lower values than NFU and DH (Figure 1) because there was doubt whether R&D alone could increase the production and consumption of legumes, but the probability that this measure would occur received higher consensus (Figure 2). Outliers represented extreme positive or negative visions that this (IRD) measure alone could either solve the problem, or that it would not be possible to modify the system at this point since it is locked in.

The probability that NFU would lead to change was less clear, as the score values were widespread and ranged from 1 to 5 (Figure 2), indicating that the participants had contrasting views. Some participants voiced the fear that such a measure could negatively affect the entire agricultural sector, in particular cereal production, thus triggering an abandonment of farming altogether. As reported in the comments by some of the participants, this policy intervention is likely to produce a drastic change towards higher legume production, but the success of it depends on how to make such a shift. Nutrition, diet, and health policies (DH) were rated higher. Still, such policies' impact is dependent on other policies that support innovation in food technology and incentivize short value chains. Participants pointed out that raising awareness of the benefits associated with legumes is a slow process, and the strategic design of such campaigns is key to the success of these interventions.

Policy interventions related to climate change (CCP), CAP greening (CG), CAP agricultural incentives (CI), and public food procurement (PFP) were considered of medium impact and probability, receiving values between 3 and 4 (Figures 1 and 2). Participants were in consensus about the high probability (Figure 2) that CAP-related policy interventions (CI and CG measures) would change legume consumption and production; however, the impact of these measures was less certain (Figure 1), as conventional farmers may need to be supported to meet the greening criteria and the market opportunities required to sustain these policies. Climate change policies received less consensus for impact (values ranged from 2 to 4, Figure 1) and probability (values ranged from 3 to 4, Figure 2) because of political inertia for implementing these measures and their limited scale of application. Public food procurement (PFP) had a medium impact, and the probability that this measure may change legume consumption and production is dependent on the innovative potential of food technology and the possible future change in consumer preferences and traditions.

The policy interventions that received the lowest values were changes in international trade agreements (T), transparency of data (TD) (Figures 1 and 2), and policies supporting legume production and consumption (PS). Policies in support of legume production and consumption may not be relevant because increased production of legume crops in the EU may not be possible/competitive and any of these policies must also address sustainability in general. Change in trade agreements received low support from participants who warned about complex interrelations within a globalized market (closing the gap between imported soybean sets the price level for protein crops in the EU). TD was considered to have a low impact, probably because the data are already available, and it showed no influence, according to the participants.

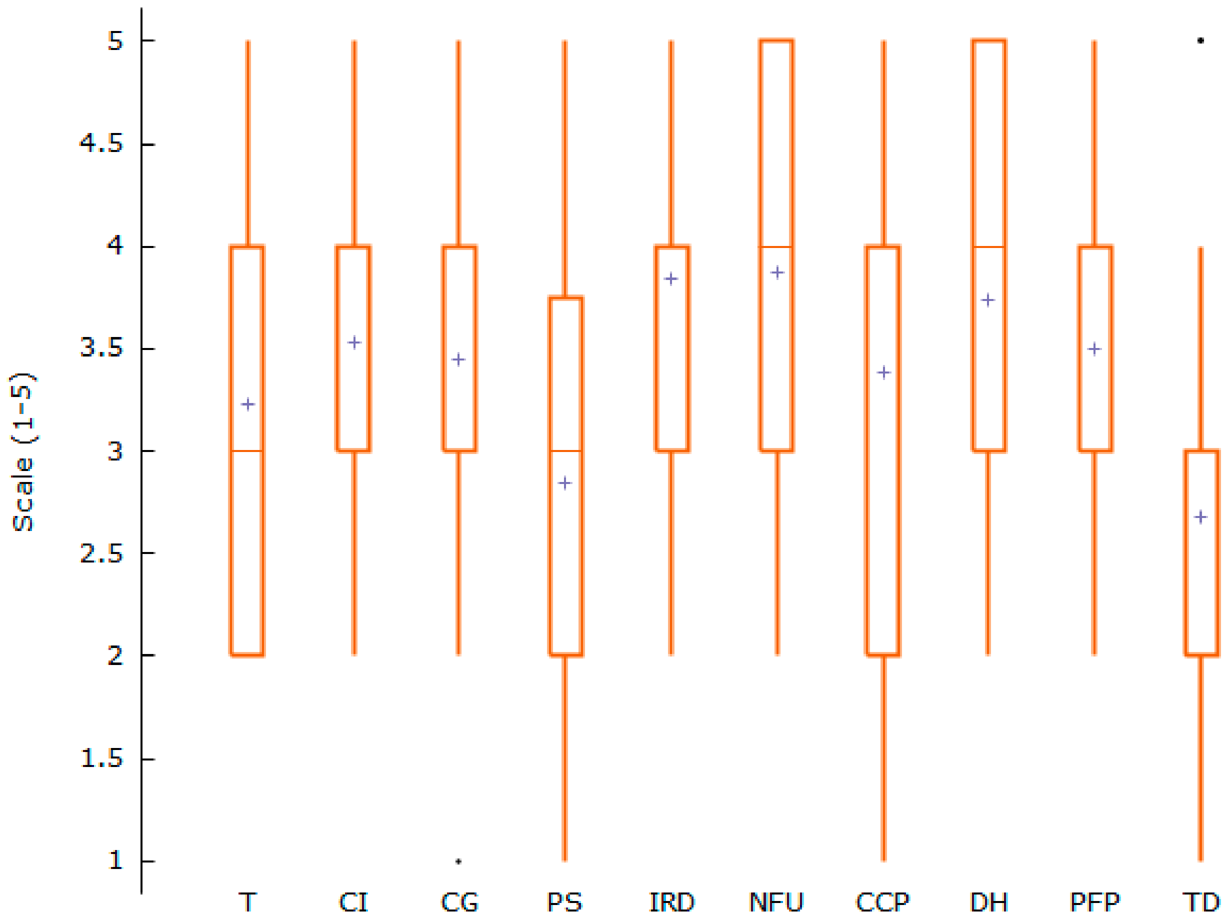


Figure 1. Boxplot assessing the impact of 10 policy interventions (described in Table 1), where T = trade policies; CI = CAP incentives; CG = CAP greening measures; PS = policy in support of legumes; IRD = investment in research and knowledge transfer; NFU = reduction in N fertilizer use; CCP = climate change policies; DH = nutrition, diet, and health policies; PFP = public food procurement; and TD = transparency of data. Impact was assessed on a 5-point scale, where 1 = very low impact, 2 = low impact, 3 = moderate impact, 4 = high impact, and 5 = very high impact. The box displays the second and third quartiles; the line shows the median value, the cross is the mean, the whiskers display the interquartile range, and dots depict outliers.

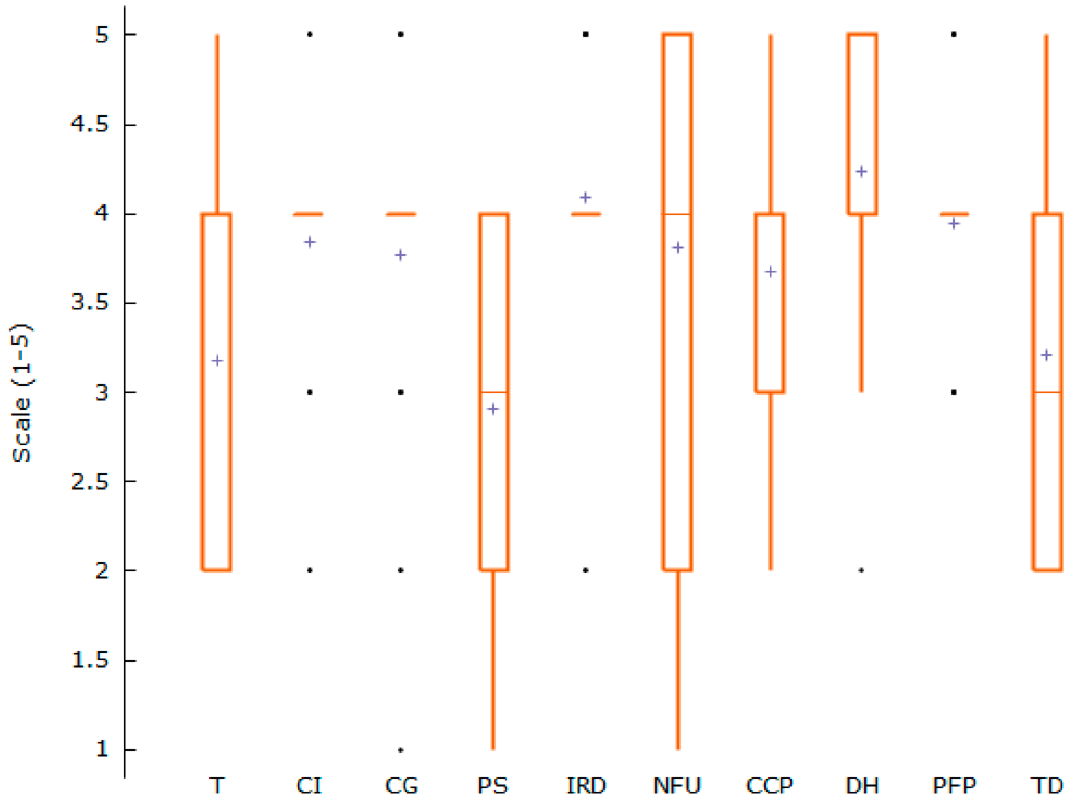


Figure 2. Boxplot assessing the probability of 10 policy interventions (described in Table 1), where T = trade policies; CI = CAP incentives; CG = CAP greening measures; PS = policy in support of legumes; IRD = investment in research and knowledge transfer; NFU = reduction in N fertilizer use; CCP = climate change policies; DH = nutrition, diet, and health policies; PFP = public food procurement; and TD = transparency of data. Impact was based on a 5-point scale, where 1 = very low probability, 2 = low probability, 3 = moderate probability, 4 = high probability, and 5 = very high probability. The box displays the second and third quartiles, the line shows the median value, the cross is the mean, the whiskers display the interquartile range, and dots depict outliers.

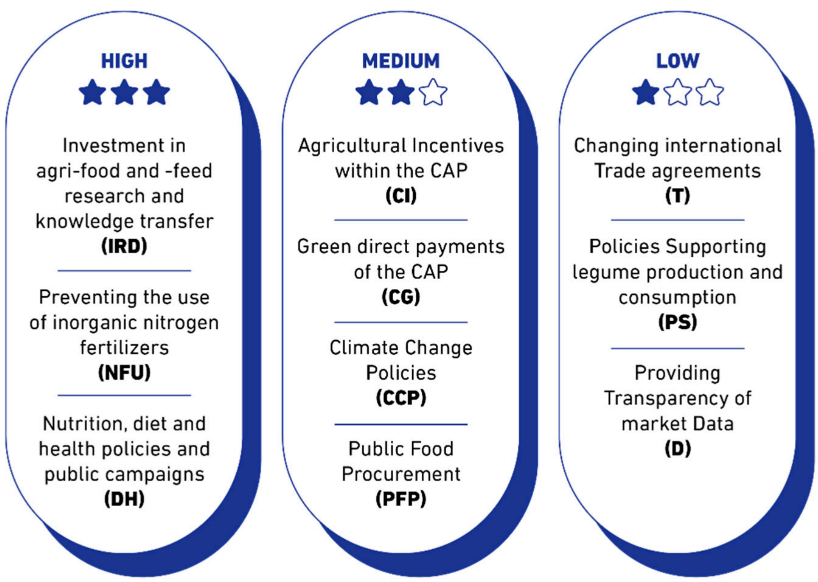


Figure 3. Summary description of participants' assessment (impact × probability, as shown in Figures 1 and 2). High = the policy has high potential to improve legume production and consumption; medium = the policy has medium potential to improve legume production and consumption; and low = the policy has low potential to improve legume production and consumption.

3.2. Round 2

Figure 4 shows the combined results of how respondents assessed the potential impact of the seven policy scenarios (Table 2) on the sustainability of EU agriculture and legume production and consumption. Participants rated the impact of eliminating the CAP as neutral or not impactful. Many commented that such a change is very drastic, and could result in a collapse in the EU agricultural sector. Few other participants (outliers) agreed that such an extreme measure is required to support the production and consumption of legumes, though the consequences may have negative social and economic repercussions if not properly implemented. The scenarios related to agricultural extension services, synthetic N fertilizer use, and R&D were considered to have a medium impact (between 5 and 6) both on EU agriculture sustainability and on legume production and consumption. The outliers in the R&D and agricultural extension services represent the vision that changes may require a structural reframing of the way agronomists and researchers are trained, because currently education in agricultural sciences is focused on cereals and oilseeds (and not on agroecological principles). Some respondents commented that reducing synthetic N fertilization may reduce yields to the extent that the whole agriculture sector would be impacted, causing an abandonment of farming altogether, as previously mentioned in Round 1. This impact—which has not occurred—was claimed before when the Water Framework Directive was implemented. Certainly, the impact of such a measure is stronger on legume consumption and production than on the sustainability of EU agriculture.

Table 2. Seven relevant policy interventions (left column) were identified in Round 1, and corresponding scenarios (right column) were discussed and ranked in Round 2.

Measure	"What If?" Scenarios
Climate measures	There will be public consensus to launch radical climate mitigation measures (e.g., requiring a significant decrease in the carbon footprint caused by food production), and collective political decisions are made in this direction.
Eliminate the CAP	A radical policy shift happens, and the EU stops all agricultural subsidies through the CAP.
Agricultural extension services	Farm advisory and agricultural extension services become fully capable (both in terms of knowledge and human and financial resources) of supporting farmers and other actors along the value chain to implement new research outcomes at the farm level.
Regulating synthetic nitrogen fertilizer use	Stricter environmental and climate regulations are applied to crop and livestock production in Europe. The new measures combine legal restrictions on synthetic N use with a system of allowances for farmers.
Nutrition, diet, and health policies	Diet and health policies build on, and at the same time share with consumers, the best available knowledge on the nutritional value and the health and environmental impacts of different food sources. Nutritional guidance on calorie intake is provided to consumers through various means (e.g., doctors, public food procurement rules, etc.).
R&D investments	Public R&D investments are focused on new breeds, effective crop rotation schemes, new strategies to recycle N better, and novel options for the storage and processing of legumes.
Trade policy	Environmental, safety, and ethical standards are increased for imported raw protein sources (used either for feed or food) to level the playing field for homegrown legumes.

Interestingly, reducing synthetic N fertilization was preferred over others because it was considered the one with the highest probability of increasing legume production and consumption (Figure 5). Climate measures were rated positively on average (mean = 6,

Figure 4) though their range was broad, and so consensus was not apparent. Similarly, trade policies were considered to have medium and high impact on legume production and consumption, and less impact on agricultural sustainability. Scenarios of nutrition, diet, and health received the highest consensus for the impact on EU agriculture sustainability, with some outliers, and less consensus for legume production and consumption. An in-depth analysis of the text and the reasons given by the participants for the assessment are provided below.

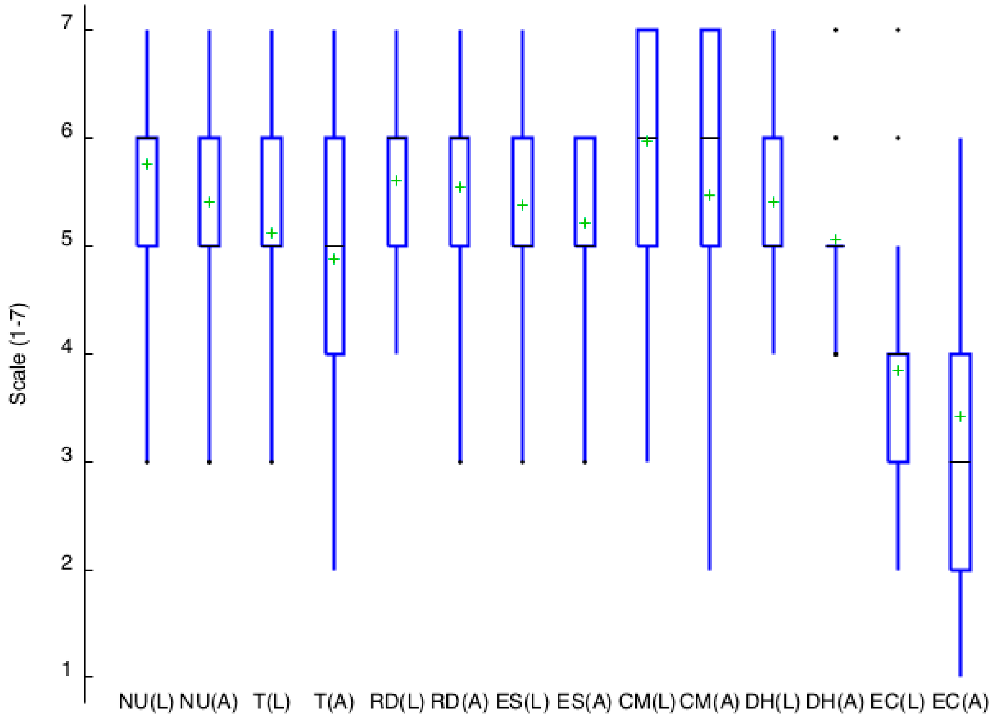


Figure 4. Boxplot of the impact assessment for the various policy scenarios described in Table 2, where NU = nitrogen fertilizer use; T = trade policies; RD = investment in research and development; ES = agricultural extension services; CM = climate measures; DH = nutrition, diet, and health; and EC = elimination of the CAP. Each policy scenario was evaluated for its impact on (L) legume production and consumption and (A) the sustainability of EU agriculture. Impact was based on a seven-point scale, where 1 = strongly not impactful, 2 = not impactful, 3 = somewhat not impactful, 4 = neutral, 5 = somewhat impactful, 6 = impactful, and 7 = strongly impactful. Each boxplot displays the second and third quartiles, the line within each box shows the median value, the whiskers display the full data range, and dots depict outliers.

4. Discussion of the Policy Scenarios

Delphi for food policy transformation is becoming increasingly popular. For example, in 2015 an international panel of food policy experts assessed the effectiveness of good food environment policies via the Delphi study by Mahesh et al. [32]. 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 were 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. [33] explored the potential development of cultured meat by 2027. The Delphi study participants doubted that the challenges of mass production, production costs, and consumer acceptance would be overcome by 2027.

Considering climate change and its impacts, consumer perceptions, and continued research and development, environmentally sustainable food systems are inevitable. In an expert Delphi, Antonelli et al. [34] explored the trends, challenges, and policy options in the agri-food sector of the Mediterranean region over the short (to 2020) and the long (to 2030) terms by developing "pessimistic" versus "optimistic" scenarios. Similarly, the assessment of country-of-origin labeling policy mobilized 19 food policy experts from 13 countries in a consensus-seeking Delphi [35]. 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. [36], there seems to be a broad consensus around the FAO definition of food and nutrition security (identifying it as access, availability, and sustainability). However, much less consensus could be recorded about the food system, which is understood in more dynamic terms, either as actor oriented (a small number of dominant agents' structure value chains), or systemic, where a mixture of stakeholders, flows, material devices, institutions, norms, beliefs, and activities constitute mixed determining factors. Note that only a few respondents referred to "intangible" dimensions of the food system in their definitions, such as governance, culture, environmental externalities, and knowledge. Allen et al. [37] proposed sustainable food system metrics specifically for the Mediterranean area and involved expert-agreed consensus in a Delphi survey regarding the indicator selection process. Frewer et al. [16] suggested exploratory workshops to refine Delphi questions and showed that beyond the relevance of the issue to the invited participant, response rates could be increased by leveraging personal networks. They also emphasized that policy uptake of the outputs of Delphi merits further research. Boylan et al. [38] 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 therefore benefit from soliciting expert opinion and consensus solution-seeking by utilizing a Delphi. Although consumer engagement in food and health policy development is rare, public discourse regarding policy options for healthy eating, or against non-communicable diet-related illness, is dominated by industry and government stakeholders. Haynes et al. [39] 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 prioritized options to reduced obesity and its impacts. In a final face-to-face discussion group, participants explored stakeholder perceptions of the intrusiveness (ethical acceptability) of obesity policy options. Hung et al. [40] investigated the challenge of improving consumer motivation and interest in healthy eating by using nutrition labels (health claims and symbols). In their policy recommendations and communication guidelines they concluded that health claims with shorter and less complicated messages and health symbols with a visible endorsement were the most highly valued and therefore more efficient.

In essence, seeking food policy transformation via foresight methods such as Delphi are becoming increasingly favored, especially when it comes to critical consensus-solution seeking or assessments of food policy instruments' legitimacy or acceptability. Agri-food policy development for sustainable food systems can benefit from a Delphi by identifying the internal incoherencies and creating new policy discourses about options and priorities that are usually dominated by industry stakeholders. Below we discuss the suite of policy options and our recommendations that may realize sustainable legume-supported food and feed systems more effectively across the value chain, from production to consumption.

4.1. Eliminate the CAP

This measure was considered too drastic because a certain level of incentives or subsidies are considered essential to support farmers' income and the economic sustainability of EU agriculture. There is a fear that in the absence of the CAP, market forces would overcome commercial competitiveness of EU farms, causing negative social, economic, and environmental consequences, including the abandonment of farming, land concentration in the hands of very few, and environmentally negative land-use changes. In addition, productivity may not change because a few large-holder farmers will acquire most of the land, and small and medium-sized landholders will cease to be commercially profitable and therefore forced out of farming. This, in turn, would have a serious impact on the economic viability of EU agriculture, and the effect on legume production would be secondary (Figure 4). A few participants commented that elimination of the CAP may be beneficial (whiskers spread to level 6, Figure 4) after careful analysis of costs and benefits and examination of the consequences of such changes in countries where this has been already implemented (i.e., New Zealand, Canada, Australia).

We argue that a reflection on CAP's future and what it can do to increase home-grown legume production must encompass the planning and coordination of the full range of CAP tools that each MS implements in its territory. Obligations on environmental and climate action are strictly dependent on local conditions and, thus, on the strategic planning and implementation within each MS. One of the proposed tools of the future CAP (post-2021) is to implement obligations and incentives for farmers to ensure that crop rotation occurs and that the temporal period of those rotations is increased, which goes beyond simply encouraging crop diversification (i.e., increasing the number of crops in the rotation) [10,41]. Encouraging lengthier crop rotations could induce an increase in legume production as an integral component of a truly holistic cropped system, and not simply for subsidy payment (i.e., greening obligations). A key lesson derived from the EU supranational Plant Protein Strategy is that optimized delivery of the plan must be targeted to accommodate regional-level considerations, such as pedoclimatic, biogeographical, and socio-economic differences [42].

4.2. Climate Measures

Many participants concentrated their answers on the suggestion of banning or limiting meat consumption and production, and therefore the impact in this policy scenario varied in a wider range (from point 2 to point 7) than in the other scenarios (Figure 4). Their main argument against reducing meat production was that it may have a strong impact on the sustainability of farming systems through reduced availability of organic N (and carbon) sources, as well as the absence of grass-lays (and reduced pesticide use, amounts, and formulations) in rotations. However, the economy of many EU regions is dependent on meat production, particularly those with limited capacity for arable operations—since some participants argued that pastures are part of the landscape, and they provide ecological benefits (such as C sequestration, biodiversity). Implementation of climate measures may cause a positive impact on both indicators if integrated farming is considered, where legumes are produced as feed and food in a low-input farming system that includes livestock as an integral part of the production unit [43]. Most participants thought that any reduction in livestock and meat production would cause a decrease in biodiversity and sustainability (Appendix C, Table A1). Potential arguments behind this opinion might be the negative biodiversity outcomes associated with the abandonment of traditional pastures, or the expected increase in land-use pressure associated with the production of meat-replacement options. According to several respondents, the decrease in biodiversity would be visible beyond the farmgate, too, as processing facilities for meat and dairy would need to be replaced, and innovation and investments would be required in new types of processing technologies for the development of plant-based products. The scenario of reducing meat production was favored only by some participants, whereas others assumed this to be currently too extreme due to political inertia and public uncertainty regarding the immediacy of the climate change risk. Reducing the dependency on plant protein imports (i.e., soybean) and/or decreasing the risks of potential protein insufficiency, mainly with respect to the animal feed requirement, is a main goal of the EC report on the development of plant proteins in the European Union, a report that does not discriminate legumes from other protein crops.

4.3. Regulating the Use of Inorganic N Fertilizers

Overall, restrictions on mineral N fertilizer use can create a positive impact on the production of legumes, whereas the impact on consumption is less certain. Increased production of legumes requires the development of a set of best practices and crop rotation schemes that are more efficient (i.e., adapted to various pedoclimates to minimize crop inputs) (Appendix C, Table A1). This measure was considered too drastic by some participants, who feared that it may push many farmers out of business, especially conventional farmers.

The inclusion of N-fixing plants such as legumes in the crop rotation or production system (grass mixes) is another management practice that replaces N fertilizer by using biological atmospheric N (N_2) as a source and making it available to the plant. Environmental co-benefits include reduced nitrate leaching, increased food sources for pollinators, greater structural diversity of farmland, and improved soil fertility [44]. However, simply regulating N fertilizer use is not enough to make the shift towards increased legume production. Closing the nutrient cycle, i.e., encouraging a circular organic-N economy, at the local, regional, and national levels, including linking urban and rural nutrient cycles, would lead to a more sustainable use of natural resources. This type of approach is partly implemented in organic farming and food systems based on agroecological principles. As highlighted in the development process of the German National Protein Strategy, this return on investment, or risk, is delivered over the longer term, such as 5–8 years compared to a single year, for the immediate commercial rewards offered by market opportunities. As such, farmers need stronger incentives to de-risk this long-term undertaking and bridge any financial shortfall [42]. It is also necessary to integrate N-fertilizer reductions with other interventions, including the breeding of new varieties (e.g., for pest resistance and higher yield), provision of independent agricultural extension services, more research and innovation, and investment in the processing capacities for legume-derived carbohydrates (i.e., fiber/starches and oils), as well as proteins to help add value and boost demand and consumption.

4.4. Agricultural Extension Services

Agricultural extension services, including farmer training and cooperative research, can have a strong and positive impact on the sustainability of EU agriculture and the potential increase in legume production and consumption (Figure 4). It was perceived that this provision would have a stronger impact on production than on consumption. Nevertheless, incentives and policies that support farmers, and other actors along the value chain, to increase legume cultivation may trigger increased demand for agricultural extension services by farmers. Currently, the EU area cultivated with legumes is very small (relative to cereals) and extension services and research agencies are not interested in developing training for agronomic support for a crop such as legumes, which can be considered marginal or underutilized (Appendix C, Table A1). Within the EU, the development of supranational protein strategies and their implementation via effective knowledge transfer is considered a pillar to realize rural areas' economic development. However, most of these strategies value legumes in a rather narrow way, mostly for their protein content, and consequently, they do not help actors along the value chain to capitalize on the multitude of benefits legumes provide for agri-food and -feed systems. Setting up producer organizations and cooperatives, and cooperation along the value chain, are additional strategies that may be adopted to decrease dependence on plant protein imports. The Farm Advisory System (FAS) is currently available to the MS, and this agency also works to ensure farmers' awareness of environmental co-benefits of long-term legume-supported crop rotations for plant protein provision.

Finally, increased funds for training, advisory, cooperation, and innovation in support of greater "fiscal literacy" were also seen as highly important: Such knowledge is very often the key to achieving both commercial profitability and environmental sustainability.

4.5. Nutrition, Diet, and Health Policies

Knowledge regarding the health and nutrition benefits of legumes may be insufficient to trigger an increase in consumption. Existing preferences and cultural barriers (Appendix C, Table A1) may be a strong deterrent to the consumption of legumes, even if nutritional, environmental, and health benefits are high, but the effective marketing of novel, easy-to-cook, tasty, and environmentally beneficial plant-based products may effectively increase legume consumption [45].

Therefore, it is important to increase investment in R&D and processing technology to create a market for high-quality plant-based products. Participants believed that impact on production from the perspectives of nutrition, diet, and health would be minimal. Nevertheless, the impact on the sustainability of EU agriculture is expected to be moderate, and the consensus amongst participants on this was high, with only a low number of outliers (Figure 4).

The market for plant-based "meat" and "dairy" products is rapidly growing, and it is predicted to reach a global net of EUR 4.2 bn by 2020. Currently, Europe is the largest market for meat substitutes, with a 39% global market share [46].

The EU plan on the development of plant proteins suggests that using demand-side policy tools, such as standardization, labeling, and public procurement, may create the necessary market pull for legume-based products and ultimately lead to lower dependence on feed protein imports.

4.6. Investing in Research and Development (R&D)

R&D can have a strong impact on legume production and the sustainability of EU agriculture (Figure 4). Legume cultivation has many technical challenges—as reported by the participants—that need to be tackled through applied research. For example, developing more effective crop types such as new varieties with higher and more-stable yields, better pest resistance, short time to harvest, and that may also minimize N loss and optimize N-cycling in-field [19]. These measures could be coupled with other types of incentives (policy reforms) to stimulate legume cultivation (Appendix C Table A1).

An opportunity to encourage the breeding of grain legumes is to ensure farmers with a minimum level of profitability [47]. Besides financial incentives within a national protein strategy, adjustments could be directed towards improving support for decentralized capacities for breeding, storage/aggregation, processing (dehulling, milling, fractionation), and marketing of local and regional legume varieties.

4.7. Reforming Trade Policies

Some participants thought that imports would become very costly because of the barriers imposed with the predicted scenario presented in this study (Appendix C Table A1). There was a fear that this policy scenario would increase food prices, with social and economic consequences; hence, the impact on the sustainability of EU agriculture spanned from low to high (Figure 4). Some participants commented that EU homegrown legumes may not be necessarily more sustainable (from "cradle to grave" life cycle assessment) than those produced outside the EU.

This integrative policy scenario may increase the competitiveness of homegrown legumes, but success demands that this approach be complemented with other reforms in R&D and innovations in production and processing, etc. To many participants, it was not clear that the EU would be able to replace imported legumes with homegrown production, as the current area cultivated with legumes and the scale of current imports do not support this vision.

5. Summary: Forging Pathways towards a More Sustainable, Legume-Based Agriculture

When participants were asked to rank the most impactful policy scenarios, regulating the use of synthetic N was the most highly ranked option (Figure 5). Elimination of the CAP was considered a very radical change, and most participants did not support it for reasons already explained above (Appendix C Table A1). A few participants commented that most of the scenarios may act negatively against other parts of the sector. Instead, they proposed to have a mix of "positive discrimination" measures in favor of legumes, such as "carbon credits" or an "environmental credit" system. The CAP should not be eliminated; instead, it can be reformed using a system of positive rewards for legume production. Currently, the EFA is the only positive support system in favor of legumes, and it has been ineffective, largely due to the associated ban on pesticide (and N fertilizer) use. Overall, participants preferred incremental changes because adaptation and preparation are needed when reforms are put in place. A radical change was deemed necessary by a small fraction of respondents (<5%), whereas it was considered a potentially costly disruption by the majority.

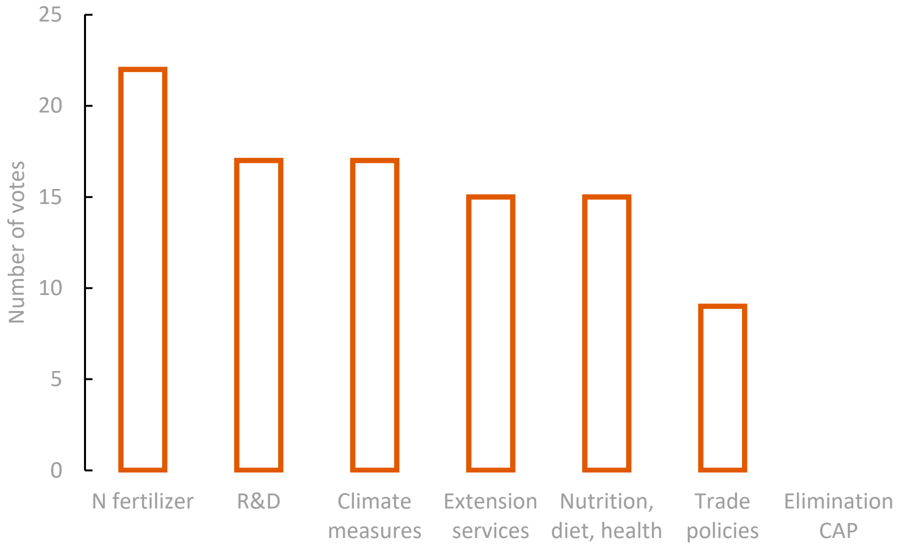


Figure 5. The number of votes given by the participants when asked to choose the three most important policy scenarios that could forge pathways towards legume-supported, sustainable food and feed systems in Europe.

The role of the institutions capable of affecting change were identified as businesses, public and state institutions, and bottom-up civic initiatives. Innovation, processing capacities, and breeding were associated with high responsibility for the private sector (business), whereas knowledge, regulations, and campaigns for awareness-raising were considered to pertain to public and state institutions. Bottom-up civic initiatives should be more concerned with activism, education, and awareness-raising.

6. Conclusions

The Delphi method aimed to assess policy options by extracting the most controversial elements. That is, although our aim was not to achieve consensus amongst stakeholders, we could identify an agreement on most of the most important questions.

- Implementing policies that encourage reduced use of inorganic N fertilizer is an important step towards a shift in the increased cultivation of legumes. It is not clear to what extent this would create an impact on the consumption of legumes.
- Investment in R&D, agricultural extension services, and knowledge transfer is necessary to support the point above and allow for a smooth transition from high use of synthetic N fertilizer in conventional agriculture to precision farming and agroecological farming.
- Mitigation and adaptation strategies to combat climate change can have an indirect positive effect on legume production and consumption if these policies are implemented on a large scale and effectively.

- Policies that tackle nutrition, health, and diet are relevant for the increase in legume consumption and, indirectly, legume production. However, preferences, culinary traditions, and cultural habits are difficult to change with top-down approaches or via promotional and information campaigns.
- Citizen-led initiatives that inform and educate the public on the environmental and health benefits of legume consumption should accompany policies that tackle production and farming strategies (i.e., greening payments with other agroecological and rural development incentives, etc.).
- The CAP is an important tool to support food production and protection of the natural environment, and of which the farm is a key component for the creation of any positive externalities. Hence, the CAP needs to be reoriented.
- Trade agreements are part of a complex web of interconnections between economies around the world, and any intervention will have repercussions along the food chain in general; therefore, this possibility is not advocated for.

A small number (<5%) of participants highlighted the importance of framing incentives instead of "punishments" (taxes, penalties, etc.) more positively for the implementation of farming practices that include legumes in the farming plan (rotations, crop mixtures, intercropping). The EC "Green Deal" aims to stimulate such a policy framework, promoting positive incentives that may work in support of legume production and consumption. By 2050, European agriculture aims to be "carbon neutral," with goals set in the Climate Act, and Directives of Renewable Energy, Energy Efficiency, Land-use Change and Emission Trading. At least 40% of the overall CAP budget for 2021–2027 would contribute to "climate action." A reduction in carbon emissions may also be coupled with reduced use of synthetic fertilizers, especially N, which need to be substituted by more environmentally friendly and diversification-focused practices, including increased legumes in the rotation, and more mixed (arable plus livestock) farmed units, which are largely self-sufficient in animal feed provision.

The most important sections of the Green Deal for the increased production and consumption of legumes are within the "Farm to Fork Strategy." The strategy aims at a "fair, healthy and environmentally-friendly food system" via the introduction of a new business model focusing on performance rather than compliance. Within this framework, eco-schemes reward farmers for improved environment and climate performance, including carbon capture and retention and improving nutrient management to enhance the quality of water and reduce GHG emissions. These practices shall be financially stimulated within the CAP and other public or private initiatives. The Loss of Nutrient Strategy entails a reduction in nutrient losses by 50% and a reduction in fertilizer use by 20% by 2030. Reducing pesticide use (50% by 2050) is another strategy within the Green Deal that may favor R&D investment in leguminous crops.

The Farm to Fork Strategy also aims to reduce food processing's environmental impact, launching a process to identify new innovative food and feed processes and products such as plant-protein-rich food. Lastly, the strategy will strive to stimulate sustainable food consumption and to give consumers better information on the provenience, nutritional value, and environmental footprint of food.

Hence, the Green Deal in general, and the Farm to Fork Strategy in particular, represent a substantial policy innovation that may positively impact legume production and consumption in the EU. The question remains: Will the strategy be well implemented in the various member states, and how will the barriers and system lock-ins be overcome? For example, in this study, the provision of R&D and agricultural extension services was been as one of the most important policy instruments to increase legume production (and consumption) in Europe. However, this factor is not directly addressed in the Green Deal, and it may be a necessary factor for implementing such policy innovation. Oliver et al. (2018) [48] highlighted knowledge constraints as one of the mechanisms locking the food system into its current unsustainable state. Knowledge constraints include lack of access to specific skills and uncertainty regarding the benefits of alternative approaches—both of which are crucial aspects for the adoption of the Farm to Forks Strategy's ambitious goals by European farmers. Regional social "knowledge" or "learning clusters" and multi-stakeholder collaboration are considered necessary triggers of synergies in the bioeconomy to reduce financial barriers for innovators and SMEs (small and medium enterprises). Hassink (2005) [49] proposed learning clusters as focal points within which dependencies or lock-ins may be overcome. To implement effective regionalized social networking and education strategies, there is a need first to understand and manage the different processes of learning among the various value-chain clusters. Then, innovation-related regional actors (politicians, policymakers, chambers of commerce, trade unions, higher education institutes, public research establishments, and companies) can cooperatively and carefully identify resources in the region that could help foster development (anti-lock-ins). We support this view of empowering localized citizen-led regional clusters to implement policy innovations such as the Farm to Fork Strategy. This study identified policy interventions that can determine the future of legumes within the EU food system, and they concur with innovation policies proposed at the EU level, such as the Farm to Fork Strategy within the EU Green Deal. Nevertheless, future efforts should focus on discerning the details regarding the effective implementation of overarching policies. Systems lock-ins and path dependencies stem from well-established routines and capacities that are engrained and embedded in (often successful) local economies. Breaking lock-ins is key to the implementation of innovative policy instruments for the required rapid change toward more sustainable climate-positive cropped systems and healthier diets.

Author Contributions: Conceptualization, B.B., E.K., T.C., M.W.V., and P.P.M.I.; methodology, B.B., E.K., and T.C.; formal analysis, B.B., E.K., and T.C.; writing—original draft preparation, B.B., E.K., and T.C.; writing—review and editing, M.W.V. and P.P.M.I.; funding acquisition, M.W.V. and P.P.M.I. All authors have read and agreed to the published version of the manuscript.

Funding: TRUE (www.true-project).

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are openly available in Zenodo at http://doi.org/10.5281/zenodo.4817334.

Acknowledgments: For successfully deploying the eDelphi (https://www.edelphi.org/), the support from Hannu Linturi and Antti Kauppi at metodix.fi is greatly appreciated.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Diagram of Codes Used for Text Analysis

Explanation of Appendix A

Forty in vivo codes in the first round and 51 in vivo codes in the second round were grouped in six categories: (1) economics, (2) social, (3) environmental, (4) policies, (5) technology, and (6) farming. The mental model above shows logical links between the different categories.

In the economics category, we had one sub-category ("economic/business"), which included two codes (trade and marketing). Other codes included in the economics category were incentives, competition, value chain, demand, investment, and costs.

In the Social category there were nine codes: cultural barriers, tradition, values, preferences, complexity, health, consumption, education, and activism.

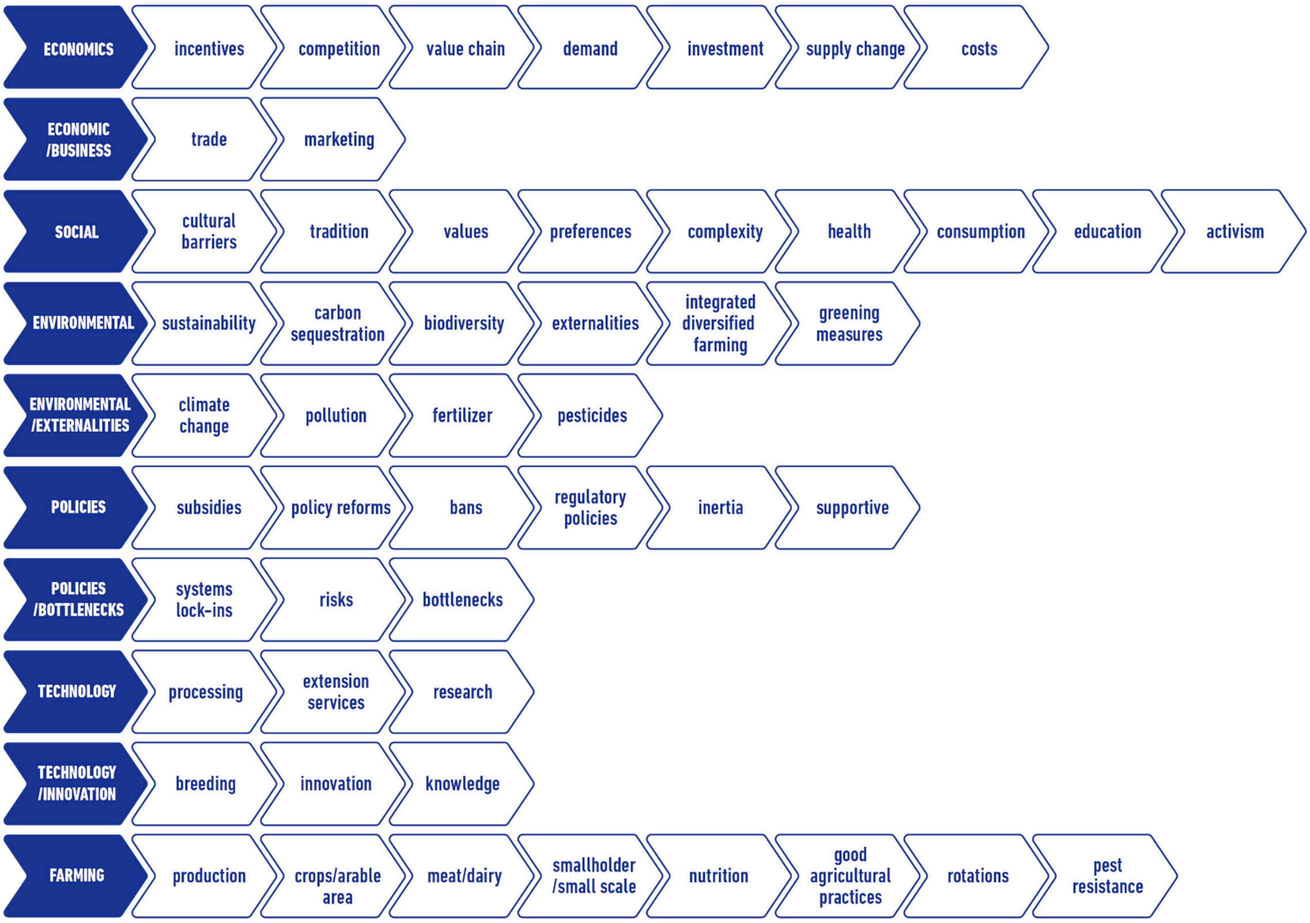
In the environmental category the six codes were sustainability, carbon sequestration, biodiversity, externalities, integrated/diversified farming, and greening measures; it also included one sub-category ("environmental/externalities") which consisted of the following codes: climate change, pollution, fertilizer, and pesticides.

In the policies category there were six codes and one sub-category with three codes. The six codes were subsidies, policy reforms, bans, regulatory policies, inertia, and supportive. The three codes for the sub-category “policies/bottlenecks” were systems lock-ins, risks, and bottlenecks.

In the technology/innovation category the five codes were processing, agricultural extension services, research, breeding, innovation, and knowledge.

In the farming category, there were eight codes: production, crops/arable area, meat/dairy, smallholder/small scale, nutrition, good agricultural practices, rotations, and pest resistance.

These codes were used to analyze the text of the comments and to quantify the codes that occurred most often (see Figure 4) in the comments for each scenario in Round 2.



Appendix B. Extract of Codes for Each Category

Category: Economic

Code	Case	Text	Number of Words	% Words
Competition	Eliminate CAP	Such a radical shift would drive many European farmers out of business and would have an impact on food supply within Europe	22	2.30%
Competition	Eliminate CAP	The fact that European land resources are substantially lower than those of other continents and the unfair commerce practises	19	2.00%
Costs	Eliminate CAP	Farmers may look for lower even more their production costs (lower their N input usually in excess in wet areas) better cropping practices and many will not be part time farmers.	31	3.20%
Competition	Eliminate CAP	Farmers may look for lower even more their production costs (lower their N input usually in excess in wet areas) better cropping practices and many will not be part time farmers.	31	3.20%
Marketing	Eliminate CAP	Then production would be driven only by the market, which is not good for sustainability	15	1.60%
Incentives	Eliminate CAP	Parts of the current CAP have positive impacts (e.g., AE funding	12	1.30%
Competition	Eliminate CAP	The market will drive production	8	0.80%
Value chain	Eliminate CAP	Would mean that the cheapest value chains will drive most of the production and consequently consumption	16	1.70%
Costs	Eliminate CAP	Cost production must be reduced	5	0.50%
Incentives	Eliminate CAP	Point is retail focus is still profit driven. and cash to shareholders. if there is no money to the farm, why would you farm at all.	26	2.70%
Competition	Eliminate CAP	Point is retail focus is still profit driven. and cash to shareholders. if there is no money to the farm, why would you farm at all.	26	2.70%
Costs	Eliminate CAP	Stopping subsidies without making prices saying the truth as well for local as for externally produced feed and food will most likely reduce the sustainability, i.e., the ability to survive for most agriculture as it is cheaper to produce outside Europe	42	4.40%

Code	Case	Text	Number of Words	% Words
Competition	Eliminate CAP	Stopping subsidies without making prices saying the truth as well for local as for externally produced feed and food will most likely reduce the sustainability, i.e., the ability to survive for most agriculture as it is cheaper to produce outside Europe	42	4.40%
Costs	Eliminate CAP	Elimination of subsidy would have a massive effect on all of agriculture and would force those that remain in production to adopt least cost production methods	26	2.70%
Trade	Climate measures	Will countries import meat and dairy from outside?	8	0.80%
Competition	Climate measures	I can also imagine that in a more competitive market for cereals and vegetables it may become advantageous to apply cheap mineral fertilizer (produced with cheap excess wind power) rather than introducing unreliable legumes in the crop rotation	38	4.00%
Investment	Climate measures	This would demand a rapid investment in processing capacities for meat and dairy replacements	14	1.50%
Incentives	Climate measures	Somewhat positive impact, but generally stronger dis/incentives are needed regarding home-grown legumes and their competition with cheap protein imports	21	2.20%
Costs	Climate measures	Politically this is not feasible. The changes in lifestyle and food production would increase food costs significantly and be unsustainable.	20	2.10%
Competition	Agricultural extension services	Question remains whether they are financially competitive.	7	0.80%
Competition	Agricultural extension services	Question remains whether they are financially competitive	7	0.80%
Costs	Agricultural extension services	Cost of their raw materials is increased	7	0.80%
Incentives	Agricultural extension services	This is a crucial point. Recovering these services will have an impact if demand, prices, consumption run parallel	18	2.10%
Value chain	Agricultural extension services	Sharing of the added value all along the value chain	10	1.10%
Demand	Agricultural extension services	Advisors will generally increase their interest with the increased exposure to the crop and demand for advice.	17	1.90%

Code	Case	Text	Number of Words	% Words
Incentives	Agricultural extension services	Their education will not necessarily in itself drive increased production. Growers preferably need to be able to make money from any crop or be made/encouraged to grow them for environmental/sustainability objective reasons	34	3.90%
Trade	Regulating synthetic N use	Maybe in increase of cheaper imports	6	0.40%
Demand	Regulating synthetic N use	Legume production is primarily linked to demand and prices.	9	0.50%
Costs	Nutrition, diet, and health	I would expect education to have a marginal impact on demand	14	1.50%
Marketing	Nutrition, diet, and health	New market for quality pulses which will increase demand	9	0.90%
Investment	Nutrition, diet, and health	At present this is likely to be supplied by North American producers rather than EU farmers as the R&D is not being undertaken by EU based organisations. Major investment in this area being made in Canada and US by food companies supported by public funds.	46	4.80%
Incentives	R&D	What sort of incentives will be allowed to farmers (such as participation schemes?)	16	1.40%
Demand	R&D	Mainly its profitability for farmers	5	0.40%
Investment	R&D	Investment in legume crop development at the farm level is needed urgently.	12	1.10%
Investment	R&D	Investment in new and novel processing will create market demand and the opportunity for growers to profit by supplying new markets with added value. I see investment in new varieties of legumes as important	34	3.00%
Demand	Trade policy	It would improve their place in the market	7	0.50%
Costs	Trade policy	Perhaps they would be happy to pay this cost	9	0.70%
Competition	Trade policy	Increased environmental, safety and ethical standards for imported raw protein sources will inevitably raise the competitiveness of homegrown legumes.	19	1.40%
Competition	Trade policy	Competitiveness of EU legumes	4	0.30%
Trade	Trade policy	Legume exporter for food towards countries able to pay for.	10	0.70%

Code	Case	Text	Number of Words	% Words
Competition	Trade policy	It will potentially increase competitiveness of prices of EU legumes. fact is many classes for food consumption are not sufficiently grown in Europe today.	24	1.80%
Trade	Trade policy	This means trade barriers and restrictions on imports of products that do not meet the standards. This will only impact the EU production if the barriers can be made to stick and the cost of meeting the standards is so high that they cannot be overcome without cost implications that make the imports economically uncompetitive. For this lack of clarity, I have not ranked the +/− effect.	66	4.90%

Category: Social

Code	Case	Text	Number of Words	% Words
Complexity	Eliminate CAP	There are too many influences linked with that. Hard to say anything about impact	14	1.50%
Complexity	Eliminate CAP	A huge agri-food turmoil is to be expected	8	0.80%
Complexity	Eliminate CAP	If ALL subsidies would be cut, we would get a revolution. There would be no essential impact on legume production	20	2.10%
Consumption	Agricultural extension services	For consumption there should be no impact. For a sustainable agriculture a better knowledge and entrance to resources would have a bigger impact.	23	2.60%
Consumption	Regulating synthetic N use	Synthetic N might give a mild push to legume production but none to consumption, as several other commentators have noted	20	1.20%
Consumption	Regulating synthetic N use	Then, since they would be more readily available in the EU market, their consumption would increase at a second step	20	1.20%
Preferences	Regulating synthetic N use	Increasing legume consumption as foods is a harder business as it requires a substantial increase in many European countries and a change in dietary habits which usually takes a rather long time to occur	34	2.10%
Preferences	Regulating synthetic N use	To increase consumption is also necessary to make awareness raising campaigns	11	0.70%

Code	Case	Text	Number of Words	% Words
Consumption	Regulating synthetic N use	Will people consume more pulses directly as food?–probably yes BUT not due to the measures posed in this question	20	1.20%
Consumption	Regulating synthetic N use	Consumers ask already today for healthy legumes; a more vegetarian diet will increase and with that the consumption of legumes	20	1.20%
Consumption	Regulating synthetic N use	Improvement/increases in consumption is likely, in that production can be a driver for consumption in the case of legumes, i.e., increased production has the potential to increase consumption	30	1.80%
Preferences	Nutrition, diet, and health	If calories-intake is to be reduced this could mean less meat not necessarily more legumes. Humans like and eat food not only because of its nutritional value but because they enjoy the taste, flavour, and texture etc. I think people are more willing to change their diet slightly for a greater environmental benefit than for personal health.	58	6.10%
Preferences	Nutrition, diet, and health	The question is how to get it into consumer hands and then how to get them to use it. Mild positives in both axes as the outcome would be reduced consumption of animal products, with all of its on-costs, and mild increases in plant-protein production.	47	4.90%
Complexity	Nutrition, diet, and health	I think the measures suggested are important to increase the awareness of the health and environmental benefits related to increased legume food consumption for individuals. However, it is not enough to lead to significant changes in consumption patterns	38	4.00%
Cultural Barriers	Nutrition, diet, and health	We need to have a bigger variety of legume foods at market and they need to fit into the local food culture and have favourable sensory properties.	27	2.80%
Tradition	Nutrition, diet, and health	It would be important to route legumes and legume-supported foods into cultures in forms that were very tasty and in-line with their cultural expectations.	30	3.10%

Code	Case	Text	Number of Words	% Words
Tradition	Nutrition, diet, and health	Under confinement in Spain the increase in the use of grain legumes in the diets has increased significantly: the reason that was given was mainly parents or families had more time for cooking. so the demand is there built in the traditions and also nowadays the gourmet approaches	48	5.00%
Heatlh	Nutrition, diet, and health	Proteins especially legumes in human diets will increase significantly over the next 10 years. They will not only be a source of protein but provide healthier forms of carbohydrate, fibre, mineral and vitamins	33	3.50%
Heatlh	Nutrition, diet, and health	Dietary guidelines on reduction of meat consumption and increase of pulses have already shown to have impact on consumption and therewith on public health.	24	2.50%
Consumption	Nutrition, diet, and health	Dietary guidelines on reduction of meat consumption and increase of pulses have already shown to have impact on consumption and therewith on public health.	24	2.50%
Consumption	Nutrition, diet, and health	Consumer education and awareness campaigns have already led to increased consumption	11	1.20%

Category: Environmental

Code	Case	Text	Words	% Words
Sustainability	Eliminate CAP	So environmental standards would still be in effect, but farmers are not compensated? I think this would lead to economically efficient large-scale agriculture with little regard to biodiversity.	29	3.00%
Sustainability	Eliminate CAP	Positive effects on sustainability. So far, it has had a little positive effect on legume production after the 2013 reforms that followed decades of negative effects whether intended or not	30	3.10%
Sustainability	Eliminate CAP	It would make the abandonment of subsidies to threat of EU agriculture sustainability.	12	1.30%
Externalities	Eliminate CAP	I think global food prices are not determined by the true costs of production but nearly every nation subsides food production somewhat	22	2.30%
Sustainability	Eliminate CAP	Which is not good for sustainability	6	0.60%

Code	Case	Text	Words	% Words
Sustainability	Eliminate CAP	Other parts are totally counterproductive in many ways (e.g., subsidies without a clear social or environmental benefit	18	1.90%
Sustainability	Eliminate CAP	A thought about eliminating subsidies, but their careful deployment can be vital for ecological regeneration	15	1.60%
Sustainability	Eliminate CAP	Sustainability might be improved	5	0.50%
Climate change	Eliminate CAP	Add the climate change with more crop failures. you will probably rule out farming	14	1.50%
Externalities	Eliminate CAP	The question is how to make prices say the truth AND at the same time make sure that production will be massively reduced	23	2.40%
Climate change	Eliminate CAP	However, climate change may work in our favour as other regions will suffer even more from climate change than central Europe and then it may be realistic to make the prices say the truth	34	3.60%
Fertilizer	Eliminate CAP	Which would involve the much greater use of legumes to provide N and improve soil fertility. The shock would be huge, right along the value chain.	26	2.70%
Sustainability	Eliminate CAP	Which would involve the much greater use of legumes to provide N and improve soil fertility. The shock would be huge, right along the value chain.	26	2.70%
Sustainability	Climate measures	What effects is this going to have on smallholders in other countries (increased pressure on land? more pollution of water and deterioration of soil?) The question should not be whether meat and dairy should be produced or not but rather in which forms? What kind of production systems can be rated sustainable	52	5.40%
Integrated/diversified farming	Climate measures	Mixed, diverse production systems rate higher in this regard and they are also more resilient. But animals are an important part of such systems.	24	2.50%

Code	Case	Text	Words	% Words
Biodiversity	Climate measures	I am very uncertain about my answer, but my feeling is there is going to be a negative effect on legumes and overall sustainability by such a radical move. Sustainability will decrease because biodiversity associated with temporary and permanent grasslands will drastically decrease.	44	4.60%
Fertilizer	Climate measures	It may be advantageous to apply cheap mineral fertilizer (produced with cheap excess wind power) rather than introducing unreliable legumes in the crop rotation. If legumes have become a reliable source of income by then, more legumes would be used (maybe also due to a high demand for products replacing meat and dairy	51	5.30%
Sustainability	Climate measures	In such a case there would be a positive effect on production but a mild effect on sustainability	18	1.90%
Sustainability	Climate measures	Banning meat and dairy consumption altogether is not the solution for our environmental problems and might even have a negative impact on sustainability	23	2.40%
Biodiversity	Climate measures	On the other hand, we need grazing animals to use pastures (we cannot use cellulose) and crops that will not produce in dry years.	24	2.50%
Carbon sequestration	Climate measures	Animal production plays a role and C sequestration too.	14	1.50%
Sustainability	Climate measures	Again, scored on production as the studies undertaken on choice experiments have shown that what consumers say they do and how they behave are very different. Again, similar concerns with sustainability metrics as outlined in previous answers.	37	3.90%
Sustainability	Climate measures	Consumption would inevitably increase because animal protein sources are missing. Production would increase accordingly. But the sustainability would be negative, because (a) it would not be political realistic to reach such restrictions and (b) there are too many regions which depend on milk and meat production–also to keep the traditional cultural landscapes with their biodiversity	56	5.90%

Code	Case	Text	Words	% Words
Sustainability	Climate measures	Some ecosystem services, including those required for legume production, can benefit from non-intensive livestock industries. Without legume-source livestock feed, production would necessarily decrease.	25	2.60%
Sustainability	Agricultural extension services	Sustainability at landscape scale and beyond.	7	0.80%
Sustainability	Agricultural extension services	Aspects since sustainability depends.	4	0.50%
Sustainability	Agricultural extension services	Transforming EU agriculture; therefore, they would result in improving legume production and agriculture sustainability.	14	1.60%
Fertilizer	Agricultural extension services	Agrochemical (especially fertiliser) suppliers.	4	0.50%
Sustainability	Agricultural extension services	Higher impact on sustainability, legumes production and consumption are not directly affected.	12	1.40%
Externalities	Regulating synthetic N use	Restrictions on pesticide use would also be needed.	8	0.50%
Biodiversity	Regulating synthetic N use	Towards more integrated and diverse systems and would support biodiversity, water quality, soil quality etc. at the same time.	19	1.20%
Integrated/diversified farming	Regulating synthetic N use	Towards more integrated and diverse systems and would support biodiversity, water quality, soil quality etc. at the same time.	19	1.20%
Integrated/diversified farming	Regulating synthetic N use	Geographical redistribution of livestock farming (or more likely increase of slurry trafficking).	13	0.80%
Sustainability	Regulating synthetic N use	How is the sustainability being assessed? If one were to incorporate all of the costs and benefits associated with the use of synthetic N vs legumes the answer may not be straight forward as it will be highly dependent upon associated land management practises, type of legumes and region. In other words, it is very context dependent and again reliant on the wider policy mix and implementation.	67	4.10%
Sustainability	Regulating synthetic N use	Sustainability improvement is certain.	4	0.20%
Fertilizer	Regulating synthetic N use	The legumes might replace or reduce the application of fertilizers.	10	0.60%

Code	Case	Text	Words	% Words
Integrated/diversified farming	Regulating synthetic N use	I think that this policy change is going to have a positive impact on organic farming in European agriculture.... Increase of organic farmers and certified bio products.	27	1.60%
Integrated/diversified farming	Trade policy	The impact on sustainability is likely to increase slightly but other measures are needed at the same time to switch to more integrated and diverse systems.	26	1.90%
Sustainability	Trade policy	As with sustainability my concerns from the previous question would be the same. If one were to view the production of legumes across the whole of Europe would the sustainability from cradle to grave actually be better than those produced elsewhere.	44	3.30%

Category: Policy

Code	Case	Text	Words	% Words
Subsidies	Eliminate CAP	Environmental standards would still be in effect, but farmers are not compensated.	12	1.30%
Bans	Eliminate CAP	I think that this is about as likely as banning meat or pigs learning to fly.	16	1.70%
Policy reforms	Eliminate CAP	This is not to say that we should not think about making changes to subsides.	15	1.60%
Policy reforms	Eliminate CAP	This may need means tested somehow. On a country/region and/or farmer by farmer basis.	16	1.70%
Policy reforms	Eliminate CAP	They do have to be entirely refocused around sustainability concerns.	10	1.00%
Policy reforms	Eliminate CAP	Give us such ideas about the general possibilities for the agri-food sector (and also about the EU structural organization for what matters.	23	2.40%
Policy reforms	Eliminate CAP	The massive cost of Covd19 will have a major impact on EU economies over the next 10 years. Political pressure will be to reduce public expenditure and farm subsidies will be questioned. There will not be the funds available to support agriculture as in the past. The impact on EU legume production and farm sustainability may not be great but the impact on farming will be enormous.	67	7.00%

Code	Case	Text	Words	% Words
Subsidies	Eliminate CAP	It would be of danger for the small farmers, because the big ones have enough resources for the beginning and enough political influence to get any public money.	28	2.90%
Inertia	Climate measures	If this happens, then the impact will be positive. The problem is: how likely is that anything so radical will happen? It seems to me times are not ripe yet (which sounds crazy and forces us to question: then what will have the necessary effect?).	45	4.70%
Regulatory policies	Climate measures	Regulatory measurements have the highest impact on both.	8	0.80%
Regulatory policies	Agricultural extension services	Are crucial for turning regulatory conditions into profitability.	8	0.90%
Policy reforms	Agricultural extension services	The new CAP is considering backing agricultural extension services.	8	0.90%
System lock-ins	Agricultural extension services	To advise on growing legumes. Many consultants don't know much about legumes. So, it has to start from the scratch.	21	2.40%
Policy reforms	Agricultural extension services	Major obstacle. So if serious efforts to reboot this service were done.	12	1.40%
Policy reforms	Agricultural extension services	To rethink them–so, in my reply I imagined that if this policy will also touch upon this, then I definitely see a positive outcome.	25	2.80%
System lock-ins	Agricultural extension services	Training and thus also not part of the advisory work in most places one of the main stumbling blocks.	19	2.20%
Policy reforms	Agricultural extension services	Which is why policy tools that direct the operation of the 'market' is important.	14	1.60%
Regulatory policies	Regulating synthetic N use	Future regulations will play a role in inclusion of legume in crop rotations.	13	0.80%
Policy reforms	Regulating synthetic N use	Policies aimed at restricting synthetic N use will surely enhance legume area and production.	14	0.90%
Regulatory policies	Regulating synthetic N use	Stricter environmental and climate regulations related to synthetic N use will inevitably lead to favourable changes in cropping patterns and practices.	21	1.30%

Code	Case	Text	Words	% Words
Policy reforms	Regulating synthetic N use	Awareness/acceptance of the role that legumes play in the system of fixing N. As a standalone lever this is unlikely to affect significant change if there are not concurrent levers affecting awareness raising, R&D and implementation guidance, etc.	40	2.40%
System lock-ins	Regulating synthetic N use	The temptation is to believe that farmers would embrace grain legumes wholeheartedly, but they need also to be able to make a profit form their sale and to be reasonably confident in the performance of legumes as a crop. Frequently this is not the case. The inability to combat pests and diseases is a major reason why many organic growers do not produce grain legumes.	65	3.90%
Policy reforms	R&D	Is it profitable for the farmer? that's the question. and is the aim to produce for the meat farms or looking to change consumer diets to more plant based. as it won't work on standalone basis. long term it could be positive for sustainability. and improved ground conditions. but farmers will need cash crops to continue farming. protein crops for animal feed are price driven. globally. with many European countries not offering the most competitive advantages for a farmer in the global playfield. ask the question where in Europe can you start a commercial farm today and make a living as a farmer from scratch. today this is impossible investment is too high to carry. so, in addition to promote these changes. EU and EU countries will need to review the position of the farmer. a jungle of regulations will not help.	142	12.70%
Regulatory policies	R&D	Knew the position of the farmer. a jungle of regulations will not help.	13	1.20%
System lock-ins	Role of institutions in policy change	More and more open to change as they face to technological lock-ins and ask for new markets.	18	1.10%
Policy reforms	Role of institutions in policy change	Policy direction needs to be clear if the desired result is to be achieved.	14	0.80%
Policy reforms	Role of institutions in policy change	Design better policies and inform policy makers.	8	0.50%
Policy reforms	Role of institutions in policy change	Propose initiatives and set a general direction.	7	0.40%

Code	Case	Text	Words	% Words
Regulatory policies	Role of institutions in policy change	Making policy decisions/regulations that promote legume production and use, giving dietary guidelines.	13	0.80%
Regulatory policies	Role of institutions in policy change	Investments, regulations and public support.	5	0.30%
Policy reforms	Role of institutions in policy change	Imposition and implementation of policy levers with funding.	8	0.50%
Regulatory policies	Role of institutions in policy change	Environmental legislation.	2	0.10%
Regulatory policies	Role of institutions in policy change	Responsible for the laws and regulations and their implementation.	9	0.50%
Regulatory policies	Role of institutions in policy change	Regulations, clear policy and education/campaigns.	6	0.40%
Supportive	Role of institutions in policy change	To support consumer to be able to make more-sustainable food consumption choices–for themselves and the environment. Consumers cannot remain passive recipients of commercial (only) market forces.	28	1.70%
Regulatory policies	Trade policy	More strict and really able to limit the import of soy produced by destroying rain forests in Amazon, there could have a positive impact in legume production in Europe and on sustainability as well.	34	2.50%
Regulatory policies	Trade policy	Other rules and regulations (e.g., DG SAN) Also in the meat consumption, the farm-to-fork principle is increasing. More people will be sensible for the kind of animal production.	31	2.30%

Category: Technology

Code	Case	Text	Number of Words	% Words
Processing	Climate measures	There needs to be a mechanism whereby small and craft-scale capacities are available and affordable for those small scales. This is a manufacturing capacity issues, and the realisation of industrial engineering solutions targeted specifically for the small/craft scale user.	41	4.30%
Processing	Climate measures	I think legumes are a good protein, energy, fibre, and mineral source. But we still lack in good products out of legumes. But where we already have fantastic products, like some kinds of soy tofu products we will easily change the consumption pattern.	43	4.50%

Code	Case	Text	Number of Words	% Words
Agricultural extension services	Agricultural extension services	Effective agricultural extension services will likely help farmers change towards more legume production,	12	1.40%
Knowledge	Agricultural extension services	Many farmers lack adequate knowledge about legume production since they haven't done so within living memory.	17	1.90%
Knowledge	Agricultural extension services	Many farmers simply have no clue about legume production as their fathers did not grow them anymore and they were not taught about them.	24	2.70%
Knowledge	Agricultural extension services	There is little development work to show how they can improve legume crop yields on farm, so they have little interest in supporting the crop.	25	2.80%
Innovation	Agricultural extension services	Increased development work and expansion of legume crops would increase the interest of farm advisors and lead to major improvement in crop productivity,	23	2.60%
Knowledge	Agricultural extension services	A better educated value chain and more enthusiasm from advisors for the benefits and use of legumes, can only improve the situation. I can only comment from my own regional experience, and we do not have a shortage of agronomists and advisors, but their general level engagement with legumes is low,	51	5.80%
Knowledge	Agricultural extension services	Farmers get more information, advice, and knowledge. This could lead to an increased production of legumes.	16	1.80%
Knowledge	Regulating synthetic N use	As regards to sustainability this would substantially improve from legume expansion if current technical issues on legume cropping would be solved.	21	1.30%
Knowledge	Regulating synthetic N use	It is critical that legumes are managed optimally to ensure that their potential benefits are capitalised upon. It would be unfair to push farmers towards increasing legume cropping without first ensuring that the farmers have access to legume-agronomy training and support (including the use of cover-crops).	48	2.90%

Code	Case	Text	Number of Words	% Words
Breeding	Regulating synthetic N use	Also, that enough crop seeds are available for the growers to sow, and that these are for varieties which industry would like. (Note also: the cover crop seed-industry in Europe is not subject to the same QA guarantees as cash crops such as legumes, cereals etc.–in many parts of Europe getting the best out of legumes demands establishing a good cover crop afterwards–though of course they can be used as green manure in their own right).	79	4.80%
Innovation	Regulating synthetic N use	Especially if "legumes" are extended to include clovers and alfalfa which can be biorefined to extract food and feed proteins,	20	1.20%
Knowledge	Regulating synthetic N use	Grain legumes export a lot of N in the grain, forage legumes leave more N. For instance, when water availability is low such as in areas with <400 mm, vetch as forage legume or an increase in fallow can occur,	40	2.40%
Agricultural extension services	Regulating synthetic N use	This will require a lot of support from agricultural research and extension–services which have been seriously neglected in recent decades.	22	1.30%
Innovation	Regulating synthetic N use	There will be technical improvement on synthetic N to reduce the N2O gas emission,	14	0.90%
Research	Regulating synthetic N use	This will require considerable R&D work into how legumes can be best used in various rotations, on different soil types, in different climates, etc. Otherwise the effect will be a general reduction in arable crop productivity and sustainability.	40	2.40%
Knowledge	Nutrition, diet, and health	To a great extent this knowledge is already available but doesn't get beyond expert circles.	16	1.70%
Processing	Nutrition, diet, and health	I think we need to have some convenience foods made of legumes available if we truly wish to increase the consumption,	21	2.20%
Knowledge	Nutrition, diet, and health	To what extent is the capacity of food literacy (i.e., home economics and how to cook (legumes)) still taught in schools. Food and food technology education needs reinvigorated across Europe.	31	3.30%

Code	Case	Text	Number of Words	% Words
Knowledge	Nutrition, diet, and health	Better informed consumption choices, and the related nutrition, diet and health policies, will always have a significant positive impact.	19	2.00%
Knowledge	Nutrition, diet, and health	Support consumption together with a deeper education (that is: not just information available but a whole support-program, such as directions for cooking, taste lab, taste experiences, etc.), not sure how much it will affect production.	36	3.80%
Research	Nutrition, diet, and health	However, the need is to undertake research to establish the functionality of pulses for use by the food industry as a food ingredient.	23	2.40%
Processing	Nutrition, diet, and health	It is feasible to replace large amounts of wheat and maize with pulse flours as more healthy food ingredients if the food processors know how they can utilise them.	29	3.00%
Processing	Nutrition, diet, and health	Alternative foods must be promoted. Primarily however they must be tasty and attractively priced, i.e desirable. This largely means improvements in processed foods with legumes as increasing proportion of the ingredients and a price that moves peoples' attention away from animal protein sources.	43	4.50%
Processing	R&D	Improved processing for feed and food the demand may also be growing,	12	1.10%
Breeding	R&D	It is also important that the new types are also bred to optimise system functions,	14	1.30%
Breeding	R&D	New cultivars resistant to diseases (Conventional and genetic editing) and new cropping systems can facilitate introduction of (grain) legumes in rotations because farmers will have an easier task,	28	2.50%
Breeding	R&D	Are focused on new breeds,	5	0.40%
Processing	R&D	Novel options for the storage and processing of legumes will have some positive impact,	14	1.30%
Knowledge	R&D	However, require more than increased knowledge,	6	0.50%
Innovation	R&D	Development of new products by the aggrotech industry not currently justified,	12	1.10%

Code	Case	Text	Number of Words	% Words
Research	R&D	Legume research will only be playing catch up in this respect and will need very considerably more input to make rapid progress,	22	2.00%
Breeding	R&D	Progression of varieties is the natural territory of the breeder BUT they are limited in their interests (as is the rest of the value chain) by the size of the market. Production of more is possible using the varieties that already exist. Regional production of species that are not already produced is one potential area that could benefit e.g., chickpeas and lentil in NW Europe, though in reality there is probably material in existence that can already be made to work in many situations IF growers see an opportunity to profit and are prepared to experiment, learn and accept some variability in performance year on year.	108	9.70%
Breeding	R&D	New breeds are urgently needed for climate adaptation.	8	0.70%
Innovation	Role of institutions in policy change	Innovations in plant-based substitutes.	5	0.30%
Knowledge	Role of institutions in policy change	It could be fact-based instead of opinion-biased.	8	0.50%
Breeding	Role of institutions in policy change	Breeding.	1	0.10%
Processing	Role of institutions in policy change	Processing legumes.	2	0.10%
Breeding	Role of institutions in policy change	Breeding of legumes with higher production and higher resistance towards pests and diseases.	13	0.80%
Innovation	Role of institutions in policy change	Entrepreneurs to develop novel food types. Food entrepreneurs to develop novel recipes containing legumes.	14	0.80%
Processing	Role of institutions in policy change	To explore or expand use of legumes in flour.	9	0.50%
Innovation	Role of institutions in policy change	Innovative products.	2	0.10%
Innovation	Role of institutions in policy change	Stainable and future-oriented technologies, innovations, goods and services.	9	0.50%
Innovation	Role of institutions in policy change	Palatability of leguminous products through the use of innovative food processing technologies	12	0.70%

Code	Case	Text	Number of Words	% Words
Processing	Role of institutions in policy change	Food industry new product development to seek ways of improving food nutritional value by using pulses and pulse products as food ingredients.	22	1.30%
Innovation	Role of institutions in policy change	Put policy into practice..	5	0.30%
Research	Role of institutions in policy change	Research, extension innovations to support farmer capacity.	7	0.40%
Knowledge	Role of institutions in policy change	Inform about options or scenarios, their conditions, and effects on and beyond agriculture based on best scientific evaluation.	18	1.10%
Knowledge	Role of institutions in policy change	Unbiased KNOWLEDGE to the policy.	5	0.30%
Knowledge	Role of institutions in policy change	Knowledge regarding legumes as part of crop rotation.	8	0.50%
Research	Role of institutions in policy change	Research into agro-food technologies.	5	0.30%
Breeding	Role of institutions in policy change	Legume breeding and the improvement of cropping systems.	9	0.50%
Agricultural extension services	Role of institutions in policy change	Providing with technical advice and incentives to the producers.	9	0.50%
Knowledge	Role of institutions in policy change	Generating knowledge and teaching.	4	0.20%
Research	Role of institutions in policy change	R&D funds to support improved legume crop productivity and use as food ingredients.	13	0.80%
Research	Role of institutions in policy change	Breeding or subsidised breeding and production research is essential as legumes start at a comparative disadvantage after years of under investment by industry. These investments are not necessarily endless but essentially filling a gap where in this case the market has failed.	43	2.60%
Breeding	Role of institutions in policy change	Breeding or subsidised breeding and production research is essential as legumes start at a comparative disadvantage after years of under investment by industry. These investments are not necessarily endless but essentially filling a gap where in this case the market has failed.	43	2.60%
Knowledge	Role of institutions in policy change	To support consumer to be able to make more-sustainable food consumption choices–for themselves and the environment. Consumers cannot remain passive recipients of commercial (only) market forces.	28	1.70%

Code	Case	Text	Number of Words	% Words
Knowledge	Role of institutions in policy change	Farmer knowledge exchange, cooperative business models.	6	0.40%
Innovation	Trade policy	Innovative products and processing methods.	5	0.40%

Category: Farming

Code	Case	Text	Words	% Words
Smallholder/small scale	Climate measures	Animals are an important part of mixed farming systems and fulfil an important traditional and cultural part for many smallholders.	20	2.10%
Nutrition	Climate measures	It is also not realistic either, so I am not in favour of this. We need to consider the whole food system and also population health, how to best fit animal production to plant production and also take into account non-food side-streams that be utilised in animal husbandry to produce high-value protein for humans.	57	6.00%
Nutrition	Climate measures	Decreasing the consumption of red meat from the current level may do us good but whole nations to move to vegan diets may expose to some serious health risks, particularly in vulnerable groups such as growing children and aged people.	40	4.20%
Production	Climate measures	Be careful with the huge increase of biomass production and the requirement to find and to develop new end uses (non-food?). 80% of the land is used to feed animals today, so the livestock reduction will offer the opportunity to grow something else: the question is what.	48	5.00%
Production	Agricultural extension services	Transforming EU agriculture; therefore, they would result in improving legume production and agriculture sustainability.	14	1.60%
Production	Agricultural extension services	Focuses on the production part, not the consumption.	8	0.90%
Meat/dairy	Agricultural extension services	Meat producers.	4	0.50%
Good agricultural practices	Agricultural extension services	Farmers thanks to good practices and high-quality products.	9	1.00%
Rotations	Agricultural extension services	rotations and the production of legumes.	8	0.90%
Crops/arable area	Agricultural extension services	As a crop area of just 3–4% is inevitably going to attract a similar proportion of the interest.	19	2.20%

Code	Case	Text	Words	% Words
Smallholder/small scale	Agricultural extension services	If all farmers would have a profit from that or if again the small family farms become forgotten.	18	2.10%
Rotations	Regulating synthetic N use	One might see a change in crop rotations.	8	0.50%
Production	Regulating synthetic N use	Clearly a policy restricting the use of synthetic N fertilisers would be favourable for legumes production.	16	1.00%
Rotations	Regulating synthetic N use	Would need quite a lot of work to optimise crop rotation etc..	13	0.80%
Rotations	Regulating synthetic N use	The limitation on N use can affect rotation sequences and legumes can be included more frequently in new rotations. What legume is introduced is another question.	26	1.60%
Production	Regulating synthetic N use	I think effect on production is different than effect on consumption. If there were to be measures to restrict the application of synthetic N fertilizer, legume production would certainly increase.	30	1.80%
Rotations	Regulating synthetic N use	As regards the implications for the sustainability of EU agriculture, clearly the potential expansion of legumes needs to be part of a new crop rotation regime in which beans & pulses co-exist with grains, roots, and tubers.	37	2.20%
Rotations	Regulating synthetic N use	Any restriction in use of N will certainly lead to a modification of the cropping systems. Rotations will be adapted to include N-fixing crops.	25	1.50%
Production	Regulating synthetic N use	Restrictions on synthetic N use will have a negative impact on crop productivity.	13	0.80%
Rotations	Regulating synthetic N use	To counter this the need will be to create a different balance in the rotations which are likely to lead to the use of more legume crops.	27	1.60%
Production	Regulating synthetic N use	Increased availability will increase consumption in the animal feed sector, perhaps at the expense of imported soya, BUT this sector may also decline if the costs of production rise and meat consumption is to be discouraged with higher prices and negative environmental messages. Consistency of availability of product is an often-declared reason for the current low level of use, therefore more availability would potentially drive consumption.	67	4.10%

Code	Case	Text	Words	% Words
Rotations	Regulating synthetic N use	Shortage of synthetic N will stimulate the use of legumes in rotation and reduce the opportunities for high protein feed.	20	1.20%
Nutrition	Nutrition, diet, and health	I could imagine that people eat more legumes if they know more about nutrition but if that will significantly change production patterns, I do not know.	26	2.70%
Pest resistance	R&D	If the R&D makes legume yield less dependent on the vagaries of weather and pests, I think farmers would be happy to include legumes in their crop rotations.	29	2.60%
Rotations	R&D	The only one of these measures to affect legume production is the crop rotation schemes.	15	1.30%
Production	R&D	Technical shortcomings of legume production, this would substantially improve their production and sustainability in EU agriculture.	16	1.40%
Pest resistance	R&D	New cultivars resistant to diseases (Conventional and genetic editing) and new cropping systems can facilitate introduction of (grain) legumes in rotations because farmers will have an easier task.	28	2.50%
Rotations	R&D	Effective crop rotation schemes, new strategies to better recycle N.	10	0.90%
Pest resistance	Trade policy	They have too many problems with diseases, weeds, and pests.	10	0.70%
Meat/dairy	Trade policy	Production of which I think have to be substantially reduced in line with EAT-Lancet proposals to cut meat consumption by half. Cheap soy meal from Brazil & elsewhere in S. America has to be eliminated in the interests of ecological restoration.	41	3.00%

Appendix C. Components of the Seven Policy Scenarios

Table A1 shows the frequency of keywords (codes) present in the participants' comments for the seven proposed scenarios. It was perceived that abandonment of the CAP would have a strong negative impact on the competitiveness and sustainability of EU agriculture. Though there was an acknowledgement that further CAP reform might be necessary, respondents advised that the CAP should not be eliminated.

Table A1. Frequencies (%) of keywords (codes) mentioned in the participants' comments in relation to the seven policy scenarios described in Table 2. Absence of data refers to frequencies <4%.

Keywords	Climate Measures	N Fertilizer	Elimination of CAP	Extension Services	Nutrition, Diet, and Health	R&D	Trade Policy
				% of Words			
Breeding		4.8				14.4	
Climate change			5.5				
Consumption		6.5					
Competition			15				
Complexity			4		4		
Costs			11				
Externalities			5				
Fertilizers	4.5						
Health					6		
Inertia	4.1						
Incentives				6			
Investment					4.8	4.1	
Knowledge		6.5		15	10.5		
Nutrition	11						
Pest resistance						4.5	
Policy reforms			13.8	6.5		12.6	4.5
Preferences					11		
Production	4.3	7.5					
Processing	8.5				9.8		
Rotations		9.5					
Subsidies			4				
System lock-ins				4.3			
Sustainability	22	4.4	14.5	4.2			
Trade							5.5
Tradition					8.2		

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