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Transitions to Legume-Based Agrifood Systems – Stakeholders' Views from Hungary

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Abstract.
The pressing need for a radical transformation towards more sustainable agricultural and food systems has staged several underutilised crops in new roles. With their effortless talent to fix nitrogen into the soil, substitute animal protein, and reduce greenhouse gas emissions, legumes are now recognised as forgotten stars that could help both agriculture and the food industry become more ecological. However, legume production and consumption, albeit with multiple advantages, remain marginal in Europe for several reasons. This article adopts an interpretative policy framework to address the legume paradox: that is, our legume-dependent agri-food systems relying on imports and simultaneously maintaining deficient production and consumption of legumes. We reviewed the current reality of legume-based food systems in Hungary via exploratory mixed-method research. We analysed the root causes of this state of the art through mapping the understanding by critical stakeholders of challenges and potentialities of legume value chains in Hungary. We also explored how the current trends could still open pathways for more legumes in production and consumption. Our results show an extremely locked-in agri-food system, and indicate that small scale producers in particular face difficulties. Challenges include shallow yield stability of legumes coupled with the dumping of cheap imports of plant-based protein food and feed and inorganic nitrogen fertilisers; virtually absent small-scale processing; consumers' unawareness of legumes' benefits and preoccupation with their gut discomfort; and food services' unwillingness to experiment with tasty plant-based protein food. In conclusion, we argue that any transition towards legume-based food and feed systems would initially require multiple stakeholders' mutual engagement in the value chains and strong policy support orchestrated by public institutions.

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1. Introduction: the demise of legumes despite multiple benefits

Legumes are underutilised assets of our food system despite many beneficial effects (Ferreira et al. 2021). Looking at human health and nutrition, legumes provide eaters with improved immunological, metabolic, and hormonal regulation, anticarcinogenic and anti-inflammatory effects, and decreased risk of cardiovascular and obesity-related diseases (Vasconcelos et al. 2020). As for agroecology, legumes effortlessly fix atmospheric nitrogen into the soil. Fixing nitrogen, the biochemical compound of every living being, is carried out by rhizobia, a group of bacteria living on the nodules of legumes' roots. Rhizobia contains nitrogenase, the enzyme that catalyses the rupture of nitrogen molecules, half of which bond with hydrogen atoms to form ammonia. Our farming systems would benefit a lot from the inclusion of legumes through symbiotic nitrogen (N) fixation, reducing the need for N fertilisers, reducing N2O emissions, improving soil composition, and increasing plant resistance to pests and diseases. To save production costs in any cropping system in the long term, legumes – through fixing air-borne nitrogen – would require much reduced or no fertiliser inputs. Crop residues ploughed into the soil mineralise, enabling the reduced fertilisation of the next crops in the rotation by nitrogen. It all contributes to decreased greenhouse gas (GHG) emissions.

To realise multiple benefits and reconsider legumes as a tonic for the tired Earth, the EU, for a long time now, has incentivised farmers to transform cropping systems, replacing soybean import with home-grown protein crops. Despite EU policymakers and authorities seeking to foster forage- and grain legume[1]–producing systems, protein crops cover less than 1% of the EU's arable land, and the whole agri-food system is overdependent on import legumes as a source of protein for the livestock sector. Whereas the EU is self-sufficient in roughage (grass and silage maise), it produces only a quarter of the oilseed (mainly soy and rapeseed meals) consumed in the EU livestock sector. This calls for an overall change in protein sourcing.

Recently we recorded a high added-value market development for legume-based foods, expected to almost double from approximately US$45 billion (2017) in value to $75 billion by 2025 (Hexa Research 2020). Nevertheless, the support of legume production in the EU has failed overall to increase legume consumption. This paradox's main component is the demise of legumes and the promotion of synthetic fertiliser-dependent crops to maintain the environmentally inefficient feed. Even where legumes account for a significant portion of crop rotations (e.g., Canada, New Zealand), these practices promote environmentally unsustainable agri-food systems by driving the global export markets for animal feed or directly for meat. Any transition towards more sustainable agriculture is hindered significantly, despite the policy recommendations, by the incumbent stakeholders. Developing an alternative that seeks the way out of the highly structured agri-food system seems to be confined to niches. A proper analysis of the current systemic constraints and the actual pathways of moving towards legume-based food systems makes clear the significant knowledge gap (Voisin et al. 2014).

Our legume-dependent agri-food systems that rely on imports and simultaneously maintain deficient production and consumption of legumes have been at the forefront of our EU-funded H2020 research project, called TRUE (TRansition paths to sUstainable legume-based systems in Europe, https://www.true-project.eu/). The overall aim of TRUE is to identify constraints and lock-ins that hinder the realisation of functional food- and feed-chains, and to identify routes to transition for a range of legumes and farm networks across Europe. Based on our initial stakeholder

[1] Grain legumes, or pulses, are legumes cultivated for their seeds.

analysis, we identified key issues to be investigated and co-produced a policy assessment (Balázs et al. 2017; Balázs, Kelemen, Centofanti, Díaz de Astarloa, et al. 2019). As the central insight, we established that the industrialisation of food systems caused a complete lock-in, and the policy domain became incoherent for legume-focussed innovation. Various sectoral policies (e.g., in agriculture, health, consumption, trade, environment, and climate mitigation) that impact our legume production, processing, distribution, and consumption work at cross-purposes, and need to be orchestrated towards the transformation of legume-based food systems. In a deliberative Delphi exercise assessing the legume paradox's main components involving 80 experts, we also identified three policy action areas and governance solutions with the highest potential to trigger transformative change (Balázs, Kelemen, Centofanti, Vasconcelos, et al. 2019). These high-potential policies are: (1.) investment in agri-food and -feed research and knowledge transfer that can increase the competitiveness of protein crops and legume-based food products; (2.) preventing the use of inorganic nitrogen fertiliser that would create incentives for more legume production; (3.) nutrition, diet, and health policies and public campaigns that could successfully promote the inclusion of legumes in the human diet, make legumes more visible, and increase imports for consumption.

Insights from the TRUE project are presented in a Hungarian case study. focussed on policies and regulatory systems to promote legumes. The main research question we posed concerns the stability and change around the legume paradox: how to lock out a locked-in system? More specifically, we ask what is state of the art, and where are the systemic constraints in Hungary? How do stakeholders perceive these? Where are the windows of opportunities for intervening in this locked-in system? Where are the pathways for moving towards a legume-based food system? Our interpretative approach relies on mixed-method research. In the following sections, we present our conceptual framework and methodological approach, followed by our policy framework addressing the legume paradox. We next present our results by analysing the legume paradox through the eyes of the stakeholders, and the windows of opportunity that emerge from our analysis in the public food sector. Finally, we discuss potential intervention points for enabling a transformation towards a legume-based food system.

2. Conceptual Framework and Methodological Approach

Since their domestication, legumes have always been the most valued components of healthy diets and rotations, and are now recognised as essential components of human and natural ecosystems via ecosystem service provision of nitrogen fixation, soil construction, and fertility maintenance. Legumes have gained substantial acknowledgement from the highest levels of international policy communities and interfaces.[2] Science policy dialogues are positioned in the subject area of food and nutrition security (FNS), emphasizing the need for innovative research to improve FNS through legumes (See, e.g., the Morocco Declaration on Pulses, in Agrawal 2017). In policy narratives, leguminous plants are often considered suspiciously, for example, as "meat analogues" in the context of population growth and a shrinking small-scale farming sector (FAO 2016). In another context, a diverse set of legume species, often higher in number than the few primarily traded grain legume commodities, and also often regionally significant, are considered indirectly as "orphan crops". However, they receive hardly any treatment, not to mention focused research attention, among food scholars (Mason and Lang 2017). There seems to be agreement in the EU

[2] For example, TEEBAgriFood, http://teebweb.org/agrifood/; IPES-Food, http://www.ipes-food.org/; and UN Decade of Action on Nutrition, https://www.unscn.org/en/topics/un-decade-of-action-on-nutrition.

research and policy communities about the overall usefulness of reintroducing protein crops, mainly legumes, to improve European agricultural systems' sustainability (see, e.g., the new Crop Diversification Cluster formed by six EU-funded research projects: cropdiversification.eu). Also, on the EU level, a transition from an agrochemical to an agroecological paradigm has been suggested many times (Häusling 2011; Helming et al. 2014; Rees et al. 2015; Magrini et al. 2016; IYOP 2016). While EU policies aim to increase the competitive advantage of the EU on the world market, and could be designed to enhance the performance of legume-based systems, the EU does not have a single coherent food policy. The food policy domain is scattered and disintegrated, and embeds conflicting needs (achieving food security, environmental protection, and climate action) into the competitive open-market principle. However, any mention of legumes or pulses is scarce and indirect.

The demise of legumes can be traced to a combination of causes. Annicchiarico (2017) argues that there are simultaneous drivers behind this marginalisation: the availability of N fertilisers and energy at low cost; the relentless simplification, specialization, and intensification of our agricultural systems; much greater support for cereal production than for legume-based cropping systems (through EU production aids, funded public research, etc.); the established role of imported soybean as the primary protein source, along with a lack of public research on this crop (as dictated by agreements between Europe and the USA); and the systematic rendering into oblivion of environmental and social costs associated with our feed-animal production systems. Similarly, Magrini et al. (2016) suggest that the marginalisation of grain legumes in the agri-food system is rooted in three leading causes: first, the historical preference for fertilised cereals and imported soy (path dependency); second, the gap in grain legume yields compared to cereals ("increasing returns to adoption"); and, third, preferring cereals for food and imported soybeans for feed (technological lock-in).

Policy analysts have also long argued that no single policy change could alter legumes' current status (Topp et al. 2014). A suite of policy innovations is required to circumvent technological lock-in, promote legumes, increase their commercial competitiveness, and move towards more sustainable food security. The Final Report of the EIP-AGRI Focus Group on Protein Crops (Schreuder and De Visser, 2014) contended that a step-by-step approach would be desirable to increase Europe's self-sufficiency in protein crop production. The report correctly underlined the importance of knowledge creation between farmers, advisors, and researchers to improve shared understanding of legume-based farming systems. EU-funded research projects, such as Legumes Futures (www.legumefutures.eu) and Legato (www.legato-fp7.eu), also pointed to the lack of understanding of long-term benefits versus short-term gains regarding policy change. However, the primary challenges were presented as the high interannual yield variability of legumes, and the lack of knowledge exchange among stakeholders that could lead to a shared understanding of pathways to sustainability. Any development is greatly dependent on coordinated, complementary policy measures rooted in an understanding of the agroecological processes governing the benefits.

Socio-technical lock-in is often regarded as reinforcing irreversible processes in production, supply chain and policy, an attribute of food systems that impedes sustainable transformation of systems dynamics (Kuokkanen et al. 2017). Analysts seek integrated approaches that can enable unlocking. Still, public policies are often too narrow to handle a complete system transformation, from production all the way to consumption. Often in food scholarship, synthetic fertilisers (nitrogen and phosphorus) are named as the main transformer component that changed the rules of the game in the food system. Others see the lock-in dating back even further, to the

proto-industrialisation of the agri-food system. A locked system, however, also undermines its existence by leading to resource scarcity (Oliver et al. 2018). In the TRUE project, we have identified and understood lock-in mechanisms from a policy perspective that sought to avoid ineffective siloed solutions. Therefore, we deliberately chose a transdisciplinary lens by bringing multiple stakeholders (multi-actors) in the dialogue around legumes. Stakeholders assessed several critical areas of constraints and enablers during Legume Innovation Networking events. The multi-actors events illuminated and pointed towards multiple leverage points for legume-based food system transformation.

Focusing on such potentials of legumes in Hungary, we performed an exploratory, mixed-methods embedded case study research (Scholz and Tietje 2002; Yin 2003). Several subunits of analysis provided spaces of integration for quantitative and qualitative methods. Our exploratory case study research methodology relies on multiple sources of evidence: a literature review; a statistical analysis of consumption and production data; a stakeholder analysis of the legume value chains; a qualitative stakeholder interview analysis; and varied stakeholder engagement exercises. To ensure the validity of the research, our data collection strategy brought together dense and rich data sets to help us understand through triangulation the current position and potentials of legumes in Hungary (Table 1). Case study 1 has been developed around the legume paradox; we analysed in detail its components and the shared and conflicting interpretation by stakeholders (see results in section 3). Case study 2 looks into the public food sector in particular, regarded by most of the stakeholders as the largest market with outstanding potential towards a legume-based food system through buyer power (see results in section 4). For both cases, we analysed secondary (statistical) data obtained from the publicly available sources of the National Statistical Office and FAOStat. Empirical data gathering took place in 2018 and 2019 through semi-structured stakeholder interviews. The sampling was theory-driven, and benefited from a stakeholder analysis, the snowball method, and online media analysis of the legume value chains actors to clarified our final list of interviewees (see Annex). We conducted 21 interviews with practitioners in their own work contexts, including farmers growing legumes, agroecologists, input providers, breeders, advocacy groups, professional networks, policymakers, academics, extension service providers, traders, consumers, and media practitioners. All interviews lasted for 60–90 minutes and were recorded, then typewritten and analysed with thematic coding. Interview questions covered the practical and policy potentialities for and challenges to increasing legume production and consumption. We gathered data on the perceived problems along the value chain, in production, processing and use; on incumbent actors and networks and their role in policy processes; and on recognised solutions, innovation potentialities, and policy lessons.

Furthermore, written notes complemented the interviews on the interviewees' experiences with and opinions of policies regulating legume production and consumption. Businesses and market intermediaries, including processors, were the least motivated to participate in our exchanges, and systematically declined our interview queries due to conflicting priorities. Later some active market players were engaged rather successfully in informal conversational interviews that explored poorly covered areas of our previous data gathering, e.g., real market opportunities, processing, and trade.

Table 1 – Summary of the main empirical steps in our research process (Source: elaborated by the authors)

Methodology applied	**Resources and people involved**	**Insights from research**	**Actor groups in the process**
Desk research	Review of the relevant literature on legumes, online media analysis	Lack of shared understanding among researchers	ESSRG researchers
Interviews with experts and practitioners	21 interviews and stakeholder map	Shared insights about the components of legume paradox and the pathways in public food	Practitioners and experts
Group discussions with experts, practitioners, and researchers	2 interactive workshops with professionals, inviting ca. 50 participants		An interested audience for the dialogues with experts and practitioners
Outreach activities	Short and long videos to extend the legacy of the stakeholder engagement	Reflections during the stakeholder engagement	ESSRG researchers' collaboration with practitioners

The data analysis followed a qualitative approach to interpret audiotaped, transcribed interview texts. Researchers' notes from informal debriefing sessions were also analysed, along with interview texts coded thematically. We clustered and condensed the codes for the analysis (Kvale 1994), so that all themes have been described based on the stakeholder views around each topic and contrasted with available external data to point out tensions and contradictions.

Our preliminary results have been shared in two interactive synthesis workshops with stakeholders, in order to cross-check the results' validity and reliability and co-create a joint interpretation of the qualitative and quantitative analysis. Following group moderation principles, researchers mostly activated techniques to support interaction, exchange, and cooperation. Later, during our Legume Innovation Networking event in Budapest, we again presented our results (on the statistical analysis, the interview study, and the public food case study) (see the event's documentation in Balázs, Kelemen, Centofanti, Díaz De Astarloa et al. 2019). The synthesis workshops benefited greatly from our review of the legume statistics, scientific literature, and the interview analyses of stakeholders' opinions of actual policies. Our joint reflections shaped our analytical framework and helped us assess the chances of any policy innovations that could facilitate a transition towards legume-based food and feed systems.[3]

3. The legume paradox and its interpretation by Hungarian stakeholders

The marginalisation of legumes, from production through commercialisation to consumption, results from a long-term historical development in Hungary that created a lock-in in the agri-food system. State of the art is illustrated by an organic farmer interviewee as follows: "Consumers will not be interested in this topic by themselves, because they lack information. Retail does not care;

[3] Video documentation of the events is available at http://www.tiny.cc/vzgqsz.

because retail will only sell products if there is a need for them. If there is no need for it, they will not sell it. At the same time, producers lack capacity." Our desk research analysed in detail the main statistical insights and empirical traits of the main elements of this lock-in. The study demonstrates the real extent of the legume paradox in cultivation, trade, and legume consumption. This is contrasted with stakeholder views from our interview study and the results of the interactive workshops.

The growers' point of view

Growers are reluctant to farm legumes, as they are regarded unprofitable compared to cereals or oilseed rape. Therefore, agriculturalists predominantly favour the specialisation of production systems over diversification. An organic premium could be a way to enable profitable cultivation. However, even our organic farming interviewee underlined that legumes in small-scale organic farming (typically cultivating a half dozen varieties of beans and peas) "require tremendous labour input. Dried beans or fresh legumes are therefore often avoided, and cover crop mixtures are preferred". For organic growers, it is mostly the soil health that counts: "legumes are not produced for human nutrition, as there is currently no market for such premium produce". In conventional production, even cover crops, such as rapeseed or mustard, tend to be non-leguminous. The general tendency is that farmers do not recognise legumes' benefits of nitrogen fixation, reduced agrochemical costs, increased yield of subsequent crops, soil biodiversity enhancement, and emissions reduction. As emphasized by our seed industry professionals, the technology development and benchmarks that, since the Second World War, have pointed towards cereals, can hardly shift. The whole interconnected system is consistently organised around it, upstream and downstream.

Consequently, this is almost impossible to change in the dominant sector. It is mostly organic farmers who find it favourable to produce lentils and beans in Hungary, but only under the guidance of stronger brands and large-scale producers' cooperation. Robust extension services skilled in legume agronomy and crop rotations would be desirable; this could effectively support legume-based crop systems' implementation without losing gross financial margins. Furthermore, while some farmers are most often unaware of the available subsidies (ecological focus areas, agri-environmental programmes, and voluntary coupled support), others are quite uncertain about what to do when whatever subsidy programme they are on ends.

Since the 1970s, dry legume production has drastically decreased. Despite intentions to diversify, compulsory fallow periods, and agri-environmental measures, in an alarming sign of the lock-in, agricultural production is becoming cereal-centred. In essence, compared to cereals, legumes' relatively low and volatile outputs diminish their market competitiveness. As our agriculturalist interviews clarified, in a globalised agro-economy, it is the economy of scale that matters: for example, low-yielding dry legume production on marginal land in Hungary is also a primary source of non-competitiveness: "In essence, the value chain has failed; instead, there are small niche markets, while it is questionable if there is a need for large volume production in Hungary." Legume cultivation's yearly margin stays low with relatively low yields and market prices. Furthermore, as fodder, legumes as fertilisers in the rotation have even been virtually forgotten. Agricultural land area (5349 thousand hectares) covers more than half (57.5%) of Hungary's total territory. In the last 200 years of industrialising agriculture, the proportion of total land used for crops has been drastically increased: 1853: 53.8%; 1921: 73.6%; 2016: 81.0%, keeping legume production quite marginal (below 0.5%). In the last fifteen years, the amount of land devoted to legumes has stayed consistently below twenty thousand hectares, which constitutes

only 0.5% of the total cropland. Soy is an exception:[4] from 1976 to 2015, its production area doubled from thirty-nine thousand hectares to 72,582 hectares. Not surprisingly, on individual farms, the bigger the area, the more likely legumes are not included in the rotation. Whereas pulses in conventional farming reach one hundred thousand hectares, only two or three thousand hectares are farmed ecologically, altogether comprising an alarmingly low 2–3% of ecological farmlands. Intercropping (such as, for example, bean and maize) cannot be applied to vast, industrialised monocultures.

Moreover, recent droughts observed during the springs of 2017, 2018, and 2019 resulted in exceptionally low productivity of legumes, especially green peas. Without irrigation, legume production becomes tough going for most growers. As breeding experts also pointed out, "it would be super-important to develop the irrigation technologies". Taken together, the production area of the most typical legumes (beans, peas, and lentils) has drastically decreased since the 1989 political transformation, from 3.5 to 0.5%, and that decline is limiting any unlocking of the legume-based food system.

The intermediate actors' point of view

As for the commercialisation of legumes by bringing new produce, commodities, or products and services onto the market (Hamann et al., 2019), Hungary lags in value networks, diversification, and strategic partnerships for growth. It exports altogether one-fourth of its home-grown legumes. Dry beans for domestic use are mostly (77%) sourced from import, and predominantly reach processors and traders. In comparison, only a negligible 3% goes for direct consumption. Dry peas are most typically sold for feed (35%), with much less going directly to consumers (20%) or for food processing (18%). The trade balance of these crops is contradictory: the export-import ratio for dry beans is 23/77%, whereas in the case of dry peas, the proportions are more than the reverse: 84/16%. In terms of legume exports, Hungary has established trade connections with 66 countries; in Europe predominantly with Germany and Italy. Pulse exports even reach Pakistan and Morocco, whereas domestic legumes are exported as far as Jordan, Taiwan, and Iran. Pulses are mostly imported from the US, Canada, and France, while green legumes primarily come from Serbia. The difference between the production cost and the average market price has increased substantially, by fivefold.

Not surprisingly, since 2016 the area devoted to soy production has further increased by almost 50%, and while the organic soy production departs as export to Germany, six hundred thousand tonnes of soy and soy ground is still imported[5]. The Soy Production Association manager commented that "our GM-free soy, supported by the Hungarian government, leaves unprocessed to Austria and other countries and then we import GM soy grits. This is a big contradiction and causes much tension in the sector as well." Several initiatives aim to drastically reduce the EU's soy imports, including political programmes (National Protein Strategies) and public-good organisations (Donau Soja).[6] However, these efforts fail to address the demand side, specifically

[4] More than three times more soy is cultivated globally then all other legumes. Similarly to peas, soybeans are not insect pollinator-dependent. It is likely that such non-dependence benefits commercial yields.

[5] Soy ground (or soy mince, soy crumbles) is made out of textured vegetable protein. It is shaped to resemble mince, or ground beef, usually colored and seasoned so that the look and flavor of the soy product is the similar to that of beef. Soy grits are coarse ground of cleaned, toasted defatted whole soybeans.

[6] See, e.g., 'Feed protein programme to replace GMOs', https:// 2015-2019.kormany.hu/en/ministry-of-agriculture/news/feed-protein-programme-to-replace-gmos; and 'The Donau Soja Protein Strategy for Europe', http://www.donausoja.org/fileadmin/user_upload/News/DS_Protein_Transition_Strategy_final_.pdf.

the overconsumption of livestock-derived products, and to recognise that legume imports mostly cater to factory farms.

The agrotechnologists' point of view

Value creation is supported by a range of legume-related research that extends both to the downstream and upstream components of the food systems: breeding and agrotechnology, as well as product innovation and nutrition/consumption analysis. Most active research institutions, at universities and the Research Institute of Agricultural Economics, are part of the National Agricultural Research and Innovation Centre. Several specialised public and private organisations and businesses are engaged in applied and participatory research to facilitate legumes' commercialisation. Breeding legume varieties for local climatic conditions, at the Plant Production Research Institute, focusses on large seeded leguminous plants, such as green peas and green beans, mostly suitable for the processing industry. However, as our breeding experts admitted, the adoption of new varieties for the changing climatic conditions is limited mainly by the currently available inappropriate agrotechnology (irrigation and weak rotation). Even conventional breeders recognise that "Hungarian farmers do not seem to have enough knowledge and incentive to work with alternative crops; they rather count on subsidies and produce crops with the least effort. It would be important to find a spot for legumes in the production system and make farmers aware of the benefits, such as soil improvement, nitrogen fixation, and other ecological services." Breeders also recognise the marginalisation of legumes and the systemic lock-in, as "Hungarian agricultural production has shifted towards four or five plant species excluding legumes, that have an established supply chain, with appropriate varieties, technology, processing, and a calculable income. Family farmers are not big on innovation, and they rely resolutely on proven solutions." Breeding for disease and insect-pest resistance in Hungary is targetted at chickpeas, fava beans, and vetch, with conventional marker-assisted selection and breeding technologies, excluding GM. As the legume expert of the largest breeding facility in Hungary explained, breeding necessarily targets the most competitive varieties: "Breeding today only extends to green peas. Dry beans processing has become so minimal in the canning industry, and most often this is a cheap import from North Africa. Green peas became the most prominent and now provides one-third of our revenues." Furthermore, as another researcher from the breeders' community noted, "selection and breeding only makes up a tiny slice of the whole [process of] commercialisation. A much bigger slice is how to create a partnership with the growers and especially to make them understand the potential benefits." Currently, only a minority of farmers are involved in saving and improving their legume seeds. Much greater support would be necessary to encourage farmers to engage in seed stewardship projects on their farm and their communities.

The sixty non-GM soybean breeds from Hungary all rely on conventional breeding. In practice, soy cultivation is most suited to "farmers' agrotechnology, using similar machines to cereals". As the head of the Hungarian Soy Association explained, "we shouldn't fool ourselves, farmers get good money, and they are sowing what they are subsidised for". Even the soybean trade is based on before-season deals with fixed prices, and the quantities are limited. Often neither the farmers nor the traders can keep the bargain. Therefore, the value-chain management logic is "we steal the soybean [contracts] from each other; the one who offers more can immediately take farmers' produce", as the Hungarian Soy Association admitted. Even in the most competitive soybean sector, experts perceive that "EU subsidies are harmful to Hungarian agriculture, as they do not incentivise more effective cultivation. It all creates a bubble."

Seed maintenance is mainly performed at the National Centre for Biodiversity and Gene Conservation, keeping alive the genetic resources for 10665 leguminous species (Balázs, Kelemen, Centofanti, Díaz de Astarloa, et al. 2019). The greater part of this enormous number of legume varieties is entirely unused, and their genetic diversity is only maintained ex situ. The gene bank professionals pointed out that successful legume production would require varieties better adapted for new climatic conditions. However, by now legumes have become in practice completely underutilised crops, when one considers such a broad range of legume varieties stored in gene banks. On the seed market, cover crops and green manure mixes have only recently appeared. Research on the legume's biopolymers (protein, starch, fibres) is currently lacking in capacity. Remarkably, non-food uses are almost nonexistent, especially if we take into account the potential of the largest European biorefinery, established in Hungary in 2012.
Similarly, the multiplication of seed varieties cannot keep up with the retail sector's rapid changes. Though the processing industry's main actors were relatively unresponsive to our formal invitation for an interview, we did manage to map the dry and fresh product lines in the frozen, preserve, and packaging sectors. Trade is organised predominantly through the big retail chains, and to a lesser extent through alternative stores specialised in organic and natural products, or direct sale outlets (farmers markets, buying groups, CSAs). In essence, the seed system, the production system, the technical advice, and the processing industries are all organised without considering legumes. This technological paradigm is backed by research directed towards cereals and oilseed. To overcome the infrastructure deficit and technological challenges, the boosting of research and technological development towards value-added processing and co-creating novel plant-based food ingredients would be most desirable.

The consumers' point of view

The consumption of grain legumes (pulses) is decreasing due to the meatification of our diets, consumers' lack of awareness of the nutritional benefits, and prejudices about flatulence. Household consumption of legumes in Europe is alarmingly low: 2.3 kg/person/year (in 2015), from which green beans makes up 0.6 kg/person; green peas 0.8 kg/person; and dry pulses 0.9kg/person. Contrary to public health guidelines, average meat consumption is rising to 60.8 kg/person per year. In international comparison, green pea consumption in Hungary is outstanding (2.2 kg/person/year) compared to continental averages in the FAO data.[7] But compared to the world average, Hungary lags far behind (less than half) in legume consumption, whereas meat consumption is double. From recent studies (Rippin et al. 2020), we have striking evidence that Hungarian men have the highest age-standardised mean daily energy intake. These traditional diets have their toll: in terms of cancer mortality, Hungary has some of the highest rates not just in Europe but globally as well (Stefler et al. 2020). Consumers are not inclined to change eating habits, and can rely only on a limited range of legume produce, typically combined with old-fashioned food images and old ways to cook (with a great deal of fat). Household statistics also reveal that the most enthusiastic legume consumers are average-income households. However, as our agricultural economist experts revealed, the general consumer attitude is hard to change: "Only a few Hungarian consumers would swap meat for plant-based proteins. Still, the emerging alternative trends and eating habits are illustrative: organic stores handle an amazing variety of novel products, with low volumes, but still representing a remarkably high value". It is no surprise that in cross-regional comparisons, legume consumption follows a clear social-spatial pattern: the

[7] See http://www.fao.org/faostat/en/#data/CC.

southern Transdanubia region and northern Hungary show a considerably higher use of dry pulses, whereas the western Transdanubia region exhibits the most green pea consumers. The mid-Hungary region, including Budapest, is lagging in legume consumption. The smaller the settlement one lives in, the more legumes are consumed. In villages, people eat ten times more green beans and five times more green peas than in the capital, Budapest.

It is telling, as our gastro-blogger interviews revealed, that it is virtually impossible to buy Hungarian legumes, with the exception of beans: "I went through all the markets, the webshops, [and asked] friends, and figured out that the closest-produced lentil is from Poland. Another surprising finding was that only very few stores provide good quality legumes, and they do so at a remarkably high price. Also, the indifference from the gastronomy profession is very much unfounded." Food (il)literacy is traceable to several factors, as also emphasized by breeders: "Health education in schools should be improved, and the culture of family gardening brought back. On a larger scale, it would be beneficial to have a dedicated institution." All stakeholders consensually admit that government policy pushes meat consumption more than legumes, which nutritionists find especially puzzling.

Finally, the public food sector could be a large-scale market for legumes, since 10–15% of the population is involved as a consumer here (see section 4 below). As a possible outlet for promoting legumes, it currently features dried beans, lentils, green beans, and peas, as these are the most-included types in public catering. Although creative ideas or recipes are often missing from the canteens, the processing and wholesale level also operates with a narrow product range compared to the retail level. Public food experts emphasized in the interviews that canteen personnel are overworked and cannot prepare unique dishes, such as sandwich creams: "It would be favourable for processors to provide such products". Public procurement policies currently limit the access of small-scale producers to the public food sector. New products with affordable prices and novel recipes for large scale kitchens, with the involvement of processors, educators, and the gastronomic scene, would be necessary to generate more consumption: "If kitchen workers get to know new techniques and recipes, they will be more likely to find new solutions to include legumes in the menus on a broader scale".

The empirical data suggests a consensus in the sector about the lock-in, and that legumes are largely unappreciated for their role in enabling sustainable diets. It is not just the stakeholders who recognise the legume paradox, though; legume data itself is replete with paradox. Agricultural statistics on beans and peas go back to 1853, and the yearly production can be traced back to 1921, but their validity is questionable. All annual agricultural data available for the sector covers farming organisations and individual farms above the threshold of viability (circa 1500 square meters in land area). Home gardens, which are the most active in legume production, are entirely missing from the statistics. Statistics include two vegetables, nine dry pulses, and two forage legumes, but in the case of green peas, food- and feed-related production is not differentiated, and feed production data gathering extends to lupin and soy only. The data does not account for the on-farm crop diversity that provides and maintains a variety of legumes.

In conclusion, the general position of legumes in the food system in Hungary is best described as legume dependence without utilization of domestic production, with a virtual absence of any political or economic support for these protein-rich crops. To unlock the legume sector in Hungary, legume consumption needs to be made more attractive to consumers, as our interviewees explained – especially to replace much of the meat consumed. Finding the proper role for legumes would require much more orchestrated and cooperative actions, as our farmer interviewee explained: "It would be necessary to introduce long-term strategies that include the vast array of

stakeholders, and place emphasis on raising awareness among the broader public." An expert from the national Food Science Research Institute confirmed in an interview that "Consumers do not have inherently unpleasant experiences with legumes. Everybody knows about flatulence, but nothing else. It seems that people need to take it for all other benefits, especially if we promote legume consumption for health reasons. A more ecological diet cannot avoid legumes, and cookbooks and online communities are already full of such information, and also used very well."

4. New pathways and windows of opportunity in the public food sector

As our snapshot example below shows, despite weak political will and inappropriate infrastructure, private sector innovation can create opportunities towards legume-based solutions in the public food procurement sector and beyond. Innovation potential backed by existing consumer demand is already embedded in the product lines. These could be well supported by additional policies, as pointed out by stakeholders.

A general overview of the public food procurement sector

Public food procurement has gained considerable scholarly attention recently in food studies, especially the variety of civil-society and municipality-led initiatives forging change towards sustainability through food procurement policy (Morgan and Sonnino 2013). Morgan (2014) summarises the main barriers to sustainable food procurement in six main points: cost (the perception of increased expenses associated with sustainable procurement); knowledge (the lack of information and awareness); risk (the fear of innovation); leadership (the lack of ownership and accountability); inertia (the lack of incentives); and various legal issues (the uncertainty as to what can and cannot be done under existing rules). Similar barriers to creative and sustainable public food procurement had previously been identified in Hungary, contending that even though much more flexible local food sourcing had became possible, institutions and staff lacked the adequate knowledge and skills to apply the new rules (Balázs et al. 2010).

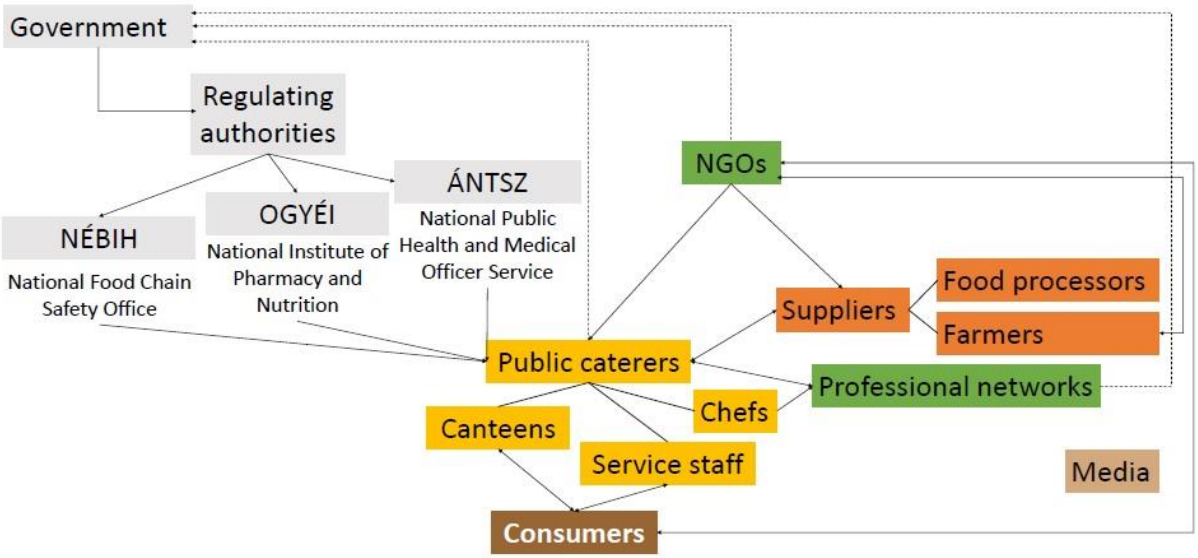
In Hungary, this is a sector that currently relies on the capacities of 3000–3500 cooking and 6000–6500 catering kitchens. Menus are supervised by catering experts and mostly delimited by the Public Food Decree (37/2014) and its Amendment (36/2016), and the Normative Instructions and Recommendations by the Chief Medical Officer of State (1/2011). These three directives limit legumes' positionality in the public food sector. They restrict in practice the preparation of dry legumes for biweekly portions. Still, as a prominent nutritional epidemiologist expert in the National Institute of Pharmacy and Nutrition also admitted, "There would be numerous intervention points for promoting legumes. The primary one is on the institutional level, where policy reforms can trigger change. For example, an average menu in Hungary features cold cuts, cold cuts, and cold cuts for breakfast, which legume products could very well replace". Schools, kindergartens, and hospitals cater to at least one-fifth of the total population (two million Hungarians) per day. Therefore, convenience products carry substantial innovation potential if the processing industry promotes wholesale packaging and affordable prices. Children, on average, consume 35–65% of their daily energy intake in school canteens (Horváth 2016). The high prevalence of obesity and nutrition-related health problems (more than 20% of children are currently overweight or obese) constitutes the fundamental argument for public food policy reform (Kovács and Erdei 2019). Securing farmers' livelihoods through localised food systems is only secondary, as public food caterers are powerful actors that can introduce quality control in food processing. Still, a recent study found that one-fourth of public canteens – quality-controlled by

the National Food Chain Safety Office in 2016 – were scored the two lowest grades, showing considerable gaps in food safety (NÉBIH 2016).

Key stakeholders in public food procurement

Public food procurement is multi-layered, and consists of governmental regulations as well as private- or NGO-led initiatives. Our embedded case study mapped the stakeholders (see figure 1), analysed policy and practice, and used interviews and media analysis to investigate how pulses are introduced and perceived in public catering.

Figure 1: Stakeholder map of the Hungarian public food policy domain (Source: authors' compilation)



As figure 1 shows, the government (especially the Ministry of Human Resources) and its regulating bodies have the primary power to initiate changes in the public food procurement sector. The Ministry is responsible for the overall policy framework of public food procurement, currently regulated at the ministerial decree level. Regulating authorities are responsible on the one hand for supporting the decisions that form the policy framework with data and professional knowledge, and on the other for supporting the policy uptake by public canteens (e.g., via guidelines, knowledge transfer, and monitoring). Legally binding requirements and strict budgetary constraints direct caterers – as one of our interviewees said, "Public caterers work in a profit-oriented way, while the decisions of local governments maintaining the canteens is highly cost-sensitive". Healthier menu planning is principally dependent on a master chef who creates a canteen's menus (on a weekly, bi-weekly, or monthly bases) based on the requirements laid down in the ministerial decree. Nutritionists are increasingly hired to help with composing the menus. However, in most cases, chefs do not have the authority to choose the supplier (not even to favour a local supplier over a non-local one), as costs are the major decisive factors in the procurement process. While chefs have a significant influence on the menus and, to some extent, also on the ingredients, they rarely meet the end consumers. It is the service provider staff at the canteen who is in a direct relationship with the consumers, and who face immediate feedback. Suppliers are

typically food-trading and -processing companies – often sourcing imported ingredients – and only very rarely farmers. A former master chef indicated that following the procurement rules, he could only buy pulses originating from China. However, these were more challenging to cook than Hungarian products. The only solution to secure an excellent quality of pulses in his kitchen was to increase the proportion of fresh beans and peas, which could be sourced from within Hungary. Consumers in public canteens are usually dependent on the service, and have minimal power to represent their interests. If the food served, for example in school or hospital canteens, is not palatable or of ample quantity for consumers, food prepared at home by parents/relatives is typically consumed as an addition or a replacement. Consumers are sometimes blamed (both by regulatory bodies and caterers) for not being open to new tastes or not being health-conscious enough, and thus hindering the shift towards more sustainable diets in public canteens. On the other hand, only a few examples exist (although the number of such cases is increasing) where consumers could have a say about their preferred choices or the service in general, or participate in attitude-forming campaigns.

Professional networks (e.g., networks of chefs or nutritionists) and NGOs play a supportive role in knowledge transfer, and build bridges between caterers, consumers, and suppliers, as well as with the governing bodies. They are the source of reliable information and international examples; therefore, they could fill knowledge gaps in the whole sector. Their level of influence, however, often depends on the personal networks and embeddedness of a few key individuals. Finally, the media regularly covers the reform process, and gives extensive voice to consumers and chefs.

Reforming the public food procurement sector

Changes in Hungarian public food provision can be dated back to 2010, when both professional organisations and regulatory authorities started to promote new nutritional guidelines. While the significant driving forces of the ongoing reform came from the governmental level, initiatives from professional networks, public caterers and social actors also contributed to changing practices and perceptions. Ironically, whereas legume consumption could very well find its way among these initiatives, none of them explicitly mentioned legumes.

Three central policies govern the public food sector in Hungary. The 1/2011 Normative Instructions and Recommendations by the Chief Medical Officer of State refers to the Law on Healthcare (CLIV/1997), which states that the food served in public catering has to meet the specific needs of consumers of different age and social groups, both in terms of quality and nutritional value. The Recommendations followed this goal by creating detailed guidelines on the energy needs of different populations and different ingredients' nutritional value. The document promotes the consumption of milk and dairy products (an average 0.5 litres of milk per person per day, or the equivalent dairy product), as well as vegetables and fruits (an average three portions per day, of which one has to be fresh), and cereals (two helpings per day on average) for each consumer group. It limits the use of fat, sugar, and salt, as well as soft drinks. Meat and meat-based products are recommended to be served each day. In the Appendix of the Recommendations, a table presents detailed information on recommended portions of different food types and ingredients. Interestingly, pulses are listed among vegetables, and are not allowed in childcare services for children under age three. The frequency of serving legumes is also limited, although not in an exact way: all through the year, pulses are allowed to be served a maximum of three times every ten days, but in the wintertime (from October to April), it is required to serve them least

once every ten days. The Recommendations' target audience is the public caterer, but indirectly it also influences the end consumers.

The 37/2014 Decree of the Ministry of Human Resources on Public Food Procurement brought into legal force the 1/2011 Recommendations, making the directions laid down in the Recommendations coercive. It states that each main course has to contain meat-based protein, but does not count pulses and legumes as additional protein sources. Pulses, as previously, are considered vegetables. A favourable change for pulses is that the Decree allows serving cold courses (e.g., sandwiches) with leguminous plants (previously legumes were allowed only as ingredients of soups, stews, salads, or side dishes). The frequency of serving pulses remains the same. Similarly to the Recommendations, the Decree targets mainly the public caterers who provide food for different consumer groups in public canteens. However, the strict limits on salt, sugar, and fat content, and the relatively massive presence of dairy products, affected not only the caterer companies but also the end consumers, who in most cases were used to different taste and ingredients.

The 36/2016 Amending Regulation of the 37/2014 Decree of the Ministry of Human Resources on Public Food Procurement was introduced after severe criticism from citizens was raised and publicised in mass media, and professional organisations initiated negotiations. The strictest limits for some ingredients (e.g. salt) were alleviated, and the size of the portions was modified, but some practical changes were issued as well in terms of controls, information provision, and requirements related to human resources. No changes were introduced for pulses.

Stakeholders' perceptions of the reforms

While the need for policy change towards more healthy diets is consensual, different constituencies have different feelings about achievements and potentials. Public authorities tend to assess the reform as a success story, even if some regulations are challenging and not met everywhere (OGYÉI 2018). They appreciate the changes in primary school canteens, which launched new ingredients , considerably increased the proportion of freshly served fruits and vegetables, and reduced fat and sugar content. However, they also acknowledge that providing detailed information remains a challenge for canteens, as does serving the minimum requirement of milk and dairy products, whole grain cereals, and nuts. They furthermore concede that in school canteens the number of parent complaints has grown since the Decree come into force, and that neither the time available for eating nor the money provided to caterers to cover the costs increased. The Decree also failed to increase the proportion of small-scale farmers as suppliers in public catering, as the procurement rules did not change for small-scale suppliers.

From the consumer point of view, satisfaction seems to be limited. According to a recent study, food waste in school canteens is around 20–25% of the total food served (Bittsánszky, 2018). In media reports, restaurants and public catering, in general, are often blamed for serving ugly and tasteless food. Eating habits are said to change only slowly, which has not been taken into account by the abrupt interventions launched by the Decree. On the other hand, caterers blame children and their families for not recognizing the healthy food choices, not knowing certain ingredients, or even not having the habit of preparing food and eating at the table, and therefore undervaluing the food served in the canteens. A former master chef we interviewed shared several stories about school children playing with and wasting the food, even when expensive or rare (e.g., high-quality grapefruits or dark chocolates, as the special Christmas offering), and thus challenging to procure. Such mutual misunderstandings between the end consumers and the food providers certainly have hindered the reforms. They also draw attention to knowledge gaps, and differences in interests and

food cultures in general. However, parallel initiatives to the policy reform (e.g., SzuperMenza, HAMM, Merőkanál, etc. – see below), targeting the end consumers by making the relationship between the caterer and the consumer more direct, might offer solutions to such conflicts.

Private and civic initiatives as an external driver for innovation

While the main driving force behind the reform of public food procurement came from the governmental level, private companies offering public food provisioning services, chefs, nutritionists, NGOs and citizens themselves initiated several actions to influence the reform by providing better information or pilot programs, or by raising their voices against the actual status of public food procurement. Although none of these initiatives focused on legumes, nor did they upscale them as a fully accepted role model, they were successful in demonstrating that alternative approaches to public food provision exist.

Professional organizations are forerunners in information provision and piloting. The Mintamenza (Canteen best practices) program[8] started as an experimental project in Békés county (southeastern Hungary) in 2010, aiming to increase the proportion of local (domestic) and seasonal food, as well as of organic products, in public canteens. It contributed to knowledge transfer by providing guidelines and professional support to public caterers, and sharing information on its website about changes in regulations and recommendations on how to meet the changing requirements. By 2014 approximately 250 school canteens had joined the program. Another example is SmartPlate (Okos tányér),[9] launched by the National Association of Hungarian Dietetists (MDOSZ) in 2016. SmartPlate is a webpage and mobile phone application, providing user-friendly information to consumers on nutritional values of food, as well as on different levels of calorie demand in different age groups. On this platform, both parents and children can quickly get information on meeting their calorie needs more healthily by using secure proxies for different ingredients and quantities.

One of the biggest public-food providers, Hungast, induced several reforms in its own practice, and communicated these to help other service providers along this path. In 2014 Hungast launched its Szupermenza (SuperCanteen) program,[10] with the core aim to change consumer perceptions and attitudes towards public catering and healthy food. It brought a market-oriented approach to the public food sector, under the slogan "Make trendy what is healthy". SuperCanteens have been established in some locations, which offer consumers healthier menu choices, an ambient environment, extended lunchtime periods, opportunities for feedback, and more information on the menu. In 2017 the company launched HAMM (National Ingredients in Hungarian Canteens),[11] a collaboration between Hungast and some of its largest Hungarian suppliers, to stabilise high-quality supply, increase the proportion of ingredients of Hungarian origin, and foster joint product development.

Among initiatives launched by NGOs, we highlight the Canteen Revolution (Menzaforradalom), a public campaign launched by Greenpeace in 2018.[12] The campaign targeted

[8]URL: http://www.mnhsz.com/mintamenza

[9]URL: http://mdosz.hu/uj-taplalkozasi-ajanlasok-okos-tanyer/

[10]URL: https://www.hungast.hu/szupermenza.html

[11]URL: http://elelmiszer.hu/cikk/indul_a_hamm_a_magyar_menzakon

[12]URL: https://act.greenpeace.org/ea-action/action?ea.client.id=1850&ea.campaign.id=86510

citizens generally, and aimed to increase the proportion of organic food in school canteens. Its narrative had three main messages: by providing more organic food in school canteens, children will have healthier food choices, decreasing health risks; Hungarian organic farmers can have more stable market relations; and, in the longer run, increasing organic production can also benefit the environment by decreasing pesticide use. The campaign was in line with the government's action plan, which set a goal of 30% school canteen food being organic by 2020. By collecting signatures and crowd-funding, Greenpeace, with the help of citizens, would like to increase pressure to truly realise the goals of the action plan.

To sum up, a striking insight from our case study is that even after considerable reform, public food policy still considers legumes only as vegetables and not as essential sources of protein for human diets. While green and dry legumes are preferred by consumers in canteens (lentils being the most favourite, followed by kidney beans, green peas, and green beans) (Bittsánszky 2018), nutritional qualities are still under-recognised or perceived as a gastric issue. Regulatory changes have guided the sector in a healthier direction. Yet culturally embedded eating habits and inappropriate preparation methods and cooking can make the system inert.

Private and civic initiatives are essential to increase the acceptance of legal reforms and create new partnerships. Several leverage points in the system can push legume consumption. First, there seems to be a consensual and legitimate narrative about changing towards healthy diets and decreasing food-related health risks, where legumes already have a role to play. Favourable presentation in the media of consumer preferences in public food and more awareness on how to best consume legumes is also a prerequisite. Building new partnerships and collaborations between professional networks and caterers and starting new initiatives (involving private and public actors) are also necessary to strengthen the policy transformation. Still, there is a range of limiting factors that can block more legume-based diets in public food. The main hindrance is the lack of capacity and experience of public caterers and consumers to shape the change. Without having engaged consumers in public food policymaking, and with only a limited set of opportunities for professional discussions before new regulations come into force, end consumers always were going to perceive the changes as abrupt and harmful.

6. Discussion and conclusion

A systemic view of legumes' roles in the current agri-food chain, building on stakeholders' perspectives, points towards several potential points of intervention. The principal opportunities are the currently unused capacities in the plant resources in upstream production systems: legume breeding and locally adapted landrace varieties, and the research capacities backed by occasional political ambitions for better protein sovereignty. As for successful commercialisation, it is the frozen and canned food industry actors who provide critical capacities to process legumes capable of also reaching export markets. All stakeholders regard it as the only segment that will gain a foothold in the category of premium, vegan, and ecological food. Public food provisioning, which already mobilises substantial public funding, is considered as the primary vehicle for providing transformation towards sustainable diets by promoting alternative meat analogues, pulses, or fresh legumes. Traditional ingredients, including dry beans, green peas and lentils, are still the most affordable and environmentally friendly food items, creating many more market channels. The

National Protein Strategy and the Donau Soja Association[13] have successfully mobilised the major stakeholders interested in producing more GM-free soy and alternative crops. However, this subvention-rich home-grown legume predominantly leaves the country, and, without domestic processing capacities, currently only reproduces the protein deficit. There seems to be a range of similar self-reinforcing weaknesses and risks on the horizon of the transformation towards legume-based systems. This makes any unlocking initiative quite challenging. With the benefits of legumes for direct human consumption still unclear for consumers, several legume varieties have gradually declined in recent decades. The underlying mechanisms, analysed by Magrini et al. (2016), have led to the preference for fertilised cereals and soy imports. This marginalisation has reached a critical state: today the Hungarian national list of crop varieties no longer contains any lentils. Despite strongly motivated researchers, only underfinanced and fragmented investigations target leguminous plants, without coherent support or an extension system. As a result, many stakeholders admit, legume seed maintenance will most likely be completely locked into gene banks.

The simplification of cropping systems, the low profitability of legumes, and the protein deficit could not be stopped or even compensated by purely economic incentives in the EU's Common Agricultural Policy. Any purposeful transition towards legume-based food systems needs to orchestrate economic, social, and environmental priorities. Public engagement and investment into the genetic research, processing, and distribution of legumes is the main prerequisite. Extension services would need to provide farmers with the best available knowledge on managing rotations with legumes and realising the agroecological benefits. Public programmes that bring together farmers and consumers to create new supply chain capacities, new outlets, market opportunities, and novel food innovations would help. A growing interest in locally sourced legumes is catered to by community-supported agriculture; and short, values-based, or place-based supply chains. These limited outreach channels will not stop the marginalisation of legume cultivation. However, more recognition of nutrient-rich ecological food in relatively privileged social groups is essential to maintain an economically attractive space for growers.

Technical assistance and policy support would be required to help small scale farmers' adaptation to meet the productivity, quality, and safety demands of food procurement. Although the legislation currently in effect has created a nutrition-sensitive environment and the public food is now healthier, it still lacks the proper embedding into agroecologically beneficial, locally sourced, and climate-sensitive or ecological food.

The interviews point out that while everyone regards developing the legumes sector as highly desirable, there are self-reinforcing mechanisms that are completely stifling the opportunities for any stakeholders to make a change. This overall picture does not reflect any individual stakeholder's view; rather, it enables us to see through the eyes of all other stakeholders to reflect on the inherent capacities to transform the system. The current realities do not imply that any agri-food system stakeholder would be capable of initiating a transformation. Still, stakeholders can exploit the inconsistencies or incoherencies of the system and also maintain interstices for their survival. Systematically building a network of such niche actors provides the opportunity to realise the ambition of a legume-based food system.

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[13] The Donau Soja Association was initiated by mainly Austrian food and agricultural companies to obtain GMO-free soy; see: https://www.donausoja.org/en/about-us/governance/the-organisation/.

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Annex

Interview 1 (male)	Organic farmer, CSA	Private farming enterprise
Pair interview 2 (female)	Agricultural researchers	Government research organisation
Interview 3 (male)	Dietitian, public food procurement expert	Non-profit community organisation
Interview 4 (male)	Farm-to-fork hub	Private farming enterprise
Interview 5 (male)	Legume breeder, researcher	Public research enterprise

Interview 6 (male)	Soy producer	Private farming enterprise
Interview 7 (male)	Soy producer	Private farming enterprise
Interview 8 (female)	Gastro-blogger	Community organisation
Interview 9 (female)	Legume researcher	University
Interview 10 (male)	Soy producer	Private farming enterprise
Interview 11 (male)	Legume scientist, gene bank expert	Government organisation
Interview 12 (female)	OGYÉI	Government organisation
Interview 13 (female)	Value chain expert	Ag Ministry
Interview 14 (female)	Legume expert	Government research organisation
Interview 15 (male)	Legume scientist	Government research institution
Interview 16 (female)	Supermarket chain	Business enterprise
Interview 17 (male)	Soil expert	Extension service, private farming enterprise

Interviews were carried out between October 2017 and January 2018.