EU CAP Network Focus Group

'Production of protein crops under climate change'

Mini Paper 3

Strengthening regional plant protein value chains, uniting farmers under a common identity

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Regional Plant Protein value chains

1. Aim of the paper

Plant protein sources like grain legumes are a long-known lever of food system transformation in climate change due to their diverse nutritional, agronomical, environmental and social advantages when replacing parts of the intake of animal products (Westhoek, Lesschen et al. 2014). However, in practice, the areas of legume cultivation in Europe are still limited (<3% of the arable land) and the environmental benefits can only be put into practice if also economic value chains and learning networks can be established (Mawois, Vidal et al. 2019, Notz, Topp et al. 2023). This paper is primarily directed at European farmers and value chain actors. In this report, three active networks that are working on building regional plant protein value chains are compared as examples and with the goal of enabling inspiration and peer-learning across Europe. At the same time, we intend to create a better understanding of the work and practical solutions in building value chains with plant proteins. Several systemic challenges were identified as similar for the networks as a starting point and are addressed in our assessment, these include:

- High yield fluctuations of grain legumes
- Shifting growing conditions and unpredictability of weather due to climate change
- Limited adapted varieties to northern conditions especially for "new" protein crops such as lentils, chickpeas and dry beans
- Price pressure of imported plant protein products
- Lack of regional value chains and especially pre-processing, storage and logistical infrastructure in rural areas
- Lack of consumer awareness and education for regionally grown grain legumes as a food
- Little willingness to pay a higher price for regional products

2. Definitions

a. Typical value chains in plant proteins

This paper is written from the perspective of value chain developers as defined by (Braun et al. 2022). Behind the descriptions lies an understanding of the pathway of grain legumes from breeding to the plate, in which diverse actors of the value chains are involved (see Figure 1): Schematically, the seed first runs from the breeder who

provides adapted seed material to the farm, where it is cultivated and threshed in its dry form. The raw material then goes into cleaning (for excluding weeds and other plant material, stones and other inorganic residues, as well as imperfect grains). The cleaned grains can be pre-processed (i.e. into flours, protein isolates etc.) or directly sold to the food processor or trader. The production of protein isolates entails additional processing steps such as dehulling, milling, and fractionation, requiring specialized infrastructure. Recent research highlights the relevance of side stream valorization—such as utilizing fiber- or starch-rich residues—to improve both the sustainability and economic performance of plant protein systems (Kamani et al. 2024; Galvis Sandoval et al. 2024) In reality, the processes can differ for each value chain in each region depending on the local contexts. Since in grain legumes the seed and the final product are constituted by the same plant organ, the process is portrayed as a circle (see figure 1, Appendix). While this document focuses on the farmers within the regional networks, all other actors have been involved in the process where necessary for the implementation of the plant protein value chains.

b. Plant protein and protein plants

As nitrogen-fixing plants this paper is focusing on the seeds of grain legumes as a source of plant protein, since all of the regarded networks have followed this focus.

Introduction to three European Case studies

c. The Dutch Protein farmers "Eiwitboeren van Nederland"

"Eiwitboeren van Nederland" is a producers organization uniting 120 registered farmers all over the Netherlands (Logo see figure 2, Appendix). It was officially recognized by the Dutch government in 2022 which allows the producers organization to make agreements in the value chain for her members. All members along the value chain share a common logo for communicating the Dutch origin of the pulses in a product to the consumer. The "Eiwitboeren van Nederland" want to contribute to a more sustainable agriculture by bringing back legumes to agriculture and consumption in the Netherlands: From Brown beans, kidney beans, white beans, soy, fava beans, lupins to peas the network works with the whole range of the suitable grain legumes for the area. Under the direction of the producers organization, pulse harvests are bundled into several value chains and demand and supply are balanced through a common planning of cultivation areas. The producer's organization aims to strengthen the economic position of the Dutch farmers in the value chain.

d. The Northeast German chickpea network "Kichererbsen-Ring"

The "Kichererbsen-Ring" is an informal network in which farmers, researchers and value-chain-developers work together at eye-level in order to stabilize chickpea cultivation in North-Eastern Germany (Map of the network see figure 3, Appendix) as an adaptation strategy to climate change. It has been established in 2023 in the German state of Brandenburg in collaboration of two publicly funded projects on chickpea and grain legume value chains. In this region the projects were implemented in the research organization Leibniz-Zentrum für Agrarlandschaftsforschung e.V. (ZALF) (project "LeguNet"), the joint stock company Regionalwert AG focused on investing in regional value chains stock corporation ("KIWERTa") and the Eberswalde University for Sustainable Development ("CiceRegio"). The focus on the chickpea crop was set by farmers' themselves as a response to the light soils and increasing occurrence of periods of drought.

e. Building Regional Plant Protein Value Chains in Northern Germany – The Lower Saxony initiative

In Lower Saxony, a coordinated initiative was launched to strengthen regional value chains for plant proteins—specifically peas (Pisum sativum), fava beans (Vicia faba), and soybeans (Glycine max). The project pursued a network-based approach to identify bottlenecks, mobilise stakeholders, and align production with food and bioeconomy applications. Key challenges included climate-induced yield variability, limited infrastructure for pre-processing, and insufficient market transparency. Through targeted formats such as the "Pea Networking Day" and "Fava Bean Networking Day," the initiative enabled direct exchange between farmers, breeders, processors and researchers. These events fostered alliances around off-flavour reduction, quality standardisation, and collaborative logistics.

A particular focus was placed on side stream valorisation. By-products such as pea pods and bean hulls were assessed for their potential in bio-based materials, including packaging and fibres, in collaboration with regional SMEs and research partners. The project underscored the need for regional innovation ecosystems to enable structural transformation. It laid the foundation for future expansions (e.g. chickpeas, lentils), deeper integration of public procurement, and enhanced cooperation between agriculture, processing and material science. The Lower Saxony initiative may offer valuable insights for other European regions aiming to connect legume cultivation with sustainable value creation.

Drivers and obstacles for building regional plant protein value chains

1. Organizational structure support – Transdisciplinary collaboration is key

a. Facilitation of the network must be financed (initially?)

All the regarded networks receive financial support in order to facilitate the networks. The "Kichererbsen-Ring" and the "Lower Saxony initiative" use the combination of several public funds. A key enabler was the involvement of a publicly mandated coordination body, which ensured continuity across networks and reduced fragmentation between stakeholders. The networks combined multiple funding sources under a shared strategic framework, enabling synergies across breeding, cultivation, processing and market development. However, the experience also exposed a structural gap: there is no institutional mechanism to continue network coordination once project funding ends. The perpetuation of the former networks is still in development. The "Lower Saxony initiative" follows the goal of eventually transferring the activities to the involved actors. In the case of "Kichererbsen-Ring", within the scientific institution ZALF e.V. the continuation of a close working relationship with the actors is part of the long-term scientific strategy. This way the open questions will continually be included in new projects. However, the marketing activities (mainly of KIWERTa) will be handed over to involved economic stakeholders. While organizing activities was more financially challenging for the "Eiwitboeren van Nederland" without public funding, the necessity of involving private funding has also early on clarified the perpetuation process. Next to several purpose-related donations (Dutch Arable Farming Union, Foodvalley NL, WWF, Rabobank), they have created a recognized producer organization with a membership model for the involved farmers. Depending on the collaboration form (i.e. basic access to information, use of the organization's label on products, participation in a bigger bundling campaign for a national buyer), the farmers pay a different membership (100-200 EUR) and/or share (3% of the average selling price/kg in case of a framework agreement) to the producer's organization. The fast start funding was necessary for all described case studies in order to build long-term structures.

b. Exchange within the network: peer-to-peer-learning, market alignment, access to knowledge

Creating room for collective exchange is a core activity of all the case studies. Regarding farming, all three create spaces for **peer-to-peer learning** in order to enrich the individual farming experience and share cultivation knowledge. Both the "Eiwitboeren van Nederland" and the "Kichererbsen-Ring" make use of informal Whatsapp groups for exchanging cropping-related experiences, questions and pictures along the season.
In the latter, the scientific involvement was the highest amongst the case studies. Through participative design of on-farm trials combined with on-station trials, local knowledge is created and shared. Next to evaluating and compensating farmers for their trials, researchers help with farming tasks such as the organization of rare seeds. Through the access and direct exchange with scientists and colleagues, farmers can reflect in the group and place their own results into a wider agronomical context. At the same time, researchers get better insight into the real farming challenges and can reflect their research questions to make them more practice-relevant.
Within "Eiwitboeren van Nederland" there was a special focus on the collection of relevant data for sustainability reporting (according to CSRD), that is used both for internal farmers' learning as well as valued to buyers/processors. This data translates the ecological value of legumes into an economic value for the farmer.

Market alignment and the development of new collaborations are the second pillar of exchange in all the case studies. Direct exchange amongst the stakeholders in the value chain enables mutual understanding, alignment on product specifications, volumes, and delivery conditions, and ensures that regional production is developed in response to actual market needs. The networks differ in their starting point within the "chicken and egg" dilemma of starting regional plant protein value chains (see Figure 4, Appendix): While the "Eiwitboeren van Nederland" and the "Kichererbsen-Ring" follow a farmer-centred approach, following their selection of grain legume crops and the best suited species according to the regional agricultural frame, the Lower Saxony Case follows an industry-driven value chain approach: Crops are chosen according to the established industrial processes and consumer demand: In both approaches the active participation of value chain actors is crucial for building trust, initiating pilot collaborations, and anchoring the agricultural sector in future protein value chains. The differences in the starting point has an effect on type of value chains: While value chains are developed according to the given amounts of raw material in the first two case studies (in smaller-to medium sized value chains), in the third one, the farming is adapted to meet the industry capacities. However, in any case both

farming possibilities and the market needs to be considered as a key to developing successful value chains.

In the organized activities, the moderated environment fosters transparency and trust, encouraging participants to share sensitive information and jointly address challenges. This requires relevant soft skills in the facilitator (setting a safe space, moderation, documentation). While some farmers express concern about first-mover disadvantages, the collective setting reduces perceived risk and enables the emergence of pre-competitive cooperation models. The "Eiwitboeren van Nederland" differs from the other two networks, in the sense that the producers organization is also an active industry partner working on concrete framework agreements with buyers, while the other two networks take on the role purely as facilitators.

2. A common "why" – how a shared set of values and a united mission can mobilize energy and deconstruct barriers

a. Network size and geography depends on the core mission and starting point

When looking at the farming, the networks differ widely in the "stages of farming" knowledge regarding the cultures considered. These "farming stages" are closely linked to the resulting motivations, challenges, activities and network sizes. The "Kichererbsen-Ring" works on introducing a new crop with a complete lack of farming knowledge amongst farmers and advisors. In this "young farming stage" the network involves a small number of farmers (8-15 depending on the year) that can be characterized as "early-adopters" with a high motivation, openness and willingness to try out innovations. Partly they had started testing chickpeas on their own initiative before the creation of the network.

The"Lower Saxony initiative" focuses on establishing coordinated value chains for peas, fava beans and soy by bringing together key actors across farming, processing and retail. Rather than testing new crops, the aim is to identify structural barriers—such as missing infrastructure, quality standards or contracts—and to enable scalable, regionally rooted supply systems for plant-based protein.
The initiative plays a key role in mapping the industrial protein value chain from raw material to consumer-ready product. It identifies critical infrastructure gaps—such as facilities for cleaning, dehulling, and fractionation—and connects actors across the entire chain: from upstream agriculture to midstream processing (including dry and wet fractionation) and downstream food manufacturing. Involving key processors and

brand manufacturers early ensures that regional production aligns with both current and anticipated market demands. Through structured dialogue, targeted investment strategies, and strengthened cross-sectoral collaboration, the project establishes the foundation for scalable, circular, and industry-integrated value chains for plant-based proteins. This approach moves beyond mere crop promotion, aiming instead at the long-term structural transformation of regional protein systems, with farmers, processors, and food companies actively co-developing solutions.

The "Eiwitboeren van Nederland" can be positioned stretched out between the other two, since they cover a wide range of legumes from more niche (like chickpeas) to highly established crops (like brown beans (Pinckaers, 2016) in a geographically much wider frame than the other two networks: The involved farms are spread over the whole country and can be categorized according to the legumes they grow depending on the growing regions within the Netherlands All the members are committed to grow protein crops for human consumption and are willing to experiment to regain knowledge. They are further united by their quest for good revenues that make it possible to grow protein crops on Dutch soil again after they have decreased from 35.000 ha in 1951 to about 6.000 ha in 2024. In an early farming stage such as chickpeas like in the east german network and in a part of the dutch network, the cultivation risk due to the lack of farming experience is rather high. Therefore the network concentrates on a small number of pioneers. At the same time where industry partners require larger amounts of products for a processing at scale, such as in the "Lower Saxony initiative" and parts of the "Eiwitboeren van Nederland", including a sufficient number of farmers to reach the required threshold is necessary. The initial impulse for starting the networks came from different points in the value chains. These shape the motivation and the required amount of farmers involved.

b. Overcoming Competition - farmers position in the value chain

Across all three networks, farmers share a common motivation: to be part of a progressive movement that promotes sustainable transformation in the agri-food sector while improving their economic position. This includes a desire for greater societal and financial recognition, especially among younger farmers. Each network aims to structure value chains in a way that allows farmers to capture added value, rather than merely serving as low-cost raw material suppliers.

In the "Kichererbsen-Ring", chickpeas are introduced as a climate-resilient, healthy, and tasty crop alternative that tolerates increasing spring drought and heat. Farmers, ranging from 20 to 4,000 hectares in size, demonstrate openness to experimentation

and collective risk-taking, even without secured buyers. Although some of the early pioneers were initially reluctant to share their experiences due to concerns about competition, they recognised the benefits of cooperation when faced with shared agronomic challenges such as unsuccessful germination, quality-seed availability, weed control and harvesting difficulties. Open discussions in small-group settings, peer learning between organic and conventional farms, and shared meals help to foster trust and solidarity. Direct marketing by farmers is often necessary due to a lack of regional intermediaries and the group setting has led to first collaborations amongst the farms.

The "Lower Saxony initiative" aimed to address the reluctance of farmers to cultivate legumes due to uncertainties in pricing, limited processing infrastructure and restricted market access. Rather than encouraging competition, the initiative aimed to optimize coordination between production and processing, clarify quality requirements, and identify gaps in logistics and infrastructure. By involving producers in moderated dialogue and matchmaking activities, it fostered trust and revealed opportunities for infrastructure investment and policy support to make legume cultivation more attractive and viable.

The "Eiwitboeren van Nederland" have gone one step further by forming an officially recognized producers organization with approximately 120 members. This legal status allows them to negotiate collectively and stabilize pricing models. By organizing farmers into crop-specific communities, such as faba beans or chickpeas, they strengthen their position against powerful buyers and international price competition. Rather than competing on price, members collaborate to promote Dutch-grown protein crops as a distinct and valuable category. Next to the common logo and the sustainability data they have the ambition to change the value chain structure that leads to different margins across the value chain and proposes to work with shorter chains, where the previous owners (chain links like transport, cleaning, packaging) are now hired for the value they add but the farmers remain the owners of the product (see figure 9, Appendix) While the structural diversity among members, ranging from arable to livestock farms, enhances knowledge exchange, it also requires careful coordination to overcome certification and logistical differences.

c. Advantages and challenges of collaboration between different value chain actors

Collaboration between farmers and other stakeholders in the supply chain, such as processors, traders and food manufacturers, is essential for scaling up sustainable

protein crops. However, this presents both strategic opportunities and practical challenges.

In the "Kichererbsen-Ring", the early integration of processors and traders created a shared understanding that sufficient supply volumes and reliable quality are prerequisites for effective product communication and scaling. However, the regional lack of intermediaries and infrastructure, particularly for the pre-processing of chickpeas, means that farmers often manage the marketing and logistics themselves. Industrial mills are usually built to handle high-volume crops and are not equipped to deal with the smaller, more variable batches produced by new protein crops. This has led to transitional strategies, such as outsourcing cleaning and grading as a service to facilities in other regions that cater to medium-sized volumes. While these solutions introduce additional transport costs, they enable product differentiation by quality class, which enhances marketing opportunities. Farmers themselves can categorize by quality and build direct customer relationships. Certain customer groups appreciate the high transparency that results from these value chains. However, some unresolved agronomic questions, for example around unstable emergence, leave a risk for the single farmer to not be able to provide harvest to their customer alone each year.

The "Lower Saxony initiative" also focused heavily on linking actors across the value chain rather than just supporting farmers in isolation. This included processors and end users in the food industry. The project emphasized the valorization of side streams (e.g. starch, fiber-rich residues) and the need for clear coordination across storage, processing, and product development. The fragmented nature of the legume sector, with diverse farm structures and processing requirements, necessitated targeted formats for exchange and matchmaking. Addressing these structural gaps is seen as essential to overcoming low-margin dynamics in comparison to imported goods.

For the "Eiwitboeren van Nederland", building a strong relationship with the processing industry is central to achieving their goals. Although they represent the producer side, their recognition as an official producers organization requires negotiation and alignment with buyers and processors. Their legal structure and crop-specific subgroups allow them to manage supply volumes, certification compatibility, and quality standards more effectively, making collaboration with processors more predictable and scalable.

Despite shared ambitions, collaboration is often hampered by differences in certification systems (e.g. organic vs. conventional), batch sizes, and logistical capacities. These incompatibilities make it difficult to bundle raw materials across

farms for uniform processing. Additionally, the absence of regional infrastructure for small- and medium-scale processing continues to be a bottleneck. Without targeted investment and coordination mechanisms, industry actors find it difficult to plan for long-term integration of regional legumes into their sourcing strategies.

3. A forward-looking image and a communicative Identity

a. Improving the farmer's image

More than half of Dutch consumers are additionally motivated to buy products with plant proteins if they are grown in the Netherlands. However, the recognizability of legumes such as field beans, lupine, soy and chickpeas is low, in contrast to meat and dairy. That is why the "Eiwitboeren van Nederland" has launched a logo to increase the awareness of vegetable proteins from Dutch soil (see figure 6, Appendix).

The small-scale value chains built directly between the farmer and the processors in the "Kichererbsen-Ring" have given a high communicative identity to the farmers. Conventional chickpeas are marketed directly in two farm cantines/restaurants/shops in dishes as well as dry and cooked in jars and in canned dishes with the farm identity portrayed on them. Another conventional farm markets directly to private customers in the surrounding villages in form of dried, milled chickpeas as well as dried Falafel Mix. Organic chickpeas from several farms were marketed in shape of vacuumed and cooked chickpeas, jarred soup, as Tempeh and as chickpea tofu, each by a different startup company that offers growing perspective.

For both the "Eiwitboeren van Nederland" and for the "Kichererbsen-Ring" the recognition that comes with being portrayed as an engaged pioneer, and being part of a solution is a strong motivating factor for the farmers. An example of a successful value chain developed in a project in the "Kichererbsen-Ring" is a soup now available in retail, which shows the processor, the value-chain-developer and the farmer on a chickpea field, as well as the farm and the project logo (see figure 7 and 8, Appendix). The "Eiwitboeren van Nederland" also uses their unique logo for external communication and on several products available in farm shops, webshops, foodservice and Retail (see figure 6, Appendix).

The "Lower Saxony initiative" aims to structurally integrate regional agriculture into the expanding plant-based protein market and to reduce dependency on imports by developing scalable value chains tailored to local conditions and industrial requirements. Rather than focusing on public visibility, the project facilitates direct

dialogue among farmers, processors, and retailers through targeted workshops, where expectations are clarified, quality standards defined, and production cycles coordinated. The overarching goal is to establish farmers as dependable partners within the value chain. By addressing issues such as fair pricing, logistical coordination, and the need for upstream investment, the initiative ensures the economic inclusion of regional producers from the outset of the protein transition.

b. Strategies of external Communication

For the "Kichererbsen-Ring" and the "Eiwitboeren van Nederland" the visual identity that has been given to several products through the logo created medial and political attention. An additional advantage for the "Eiwitboeren van Nederland" is that they have been given a national platform and are now seen as frontrunners in the value chain. Nevertheless, it is still difficult to convince a broad group of farmers of their chain approach. As more successful business cases are closed they see a growing number of members across the Netherlands.

The founding of a marketing organization for the "Kichererbsen-Ring" similar to the "Eiwitboeren van Nederland" would be a favourable option, but this would mean increasing the costs for the farmers to fund the organizational structure: This is not feasible at the early stage of chickpea cultivation. Through media reports on TV, radio and newspapers, newsletters, fairs, thematic dinners and social media a lot of storytelling was done.

Rather than placing the burden of legume marketing on individual farms, the "Lower Saxony initiative" focused on creating the necessary structural preconditions for meaningful participation in emerging protein value chains. Communication was used strategically to align value chain actors, reduce uncertainty, and identify joint development paths. Instead of broad campaigns or informal channels, the project relied on curated, topic-specific formats—such as the "Soy", "Pea" and "Fava Bean Networking Day," and expert round tables. These events enabled breeders, producers, processors and policymakers to engage in structured dialogue on pricing, quality, logistics, and investment needs. This approach fostered trust, transparency, and long-term coordination across the emerging regional protein value chains..

Conclusion and outlook

We hope this comparison can be inspiring for other plant protein networks and farmers within the European Union facing the need for adaptation in climate change. Summarizing the case studies (see figure 10, Appendix), it is clear that the collaboration in communities is an added value for all the participants of the value chain. Every value chain is different, but it is always important to involve all actors of the chain in order for change to be possible. The information flows within a tight network make it possible to identify matching interests in a dynamically evolving market. Our recommendation is to initially clarify common goals and ambitions of the founding members of a network, in order to strategically expand towards other relevant stakeholders. The case studies have shown that a common identity, whether expressed visually or ideally, can mobilize energy in a group. Since the transformation towards more sustainable diets and value chains is a societal one, many political, scientific, economic, agronomic stakeholders have an interest in the cause and will be motivated to join. Never underestimate how much (what appears to be) a small group of dedicated and committed stakeholders, be it farmers or processors, can achieve in a value chain!

Appendix

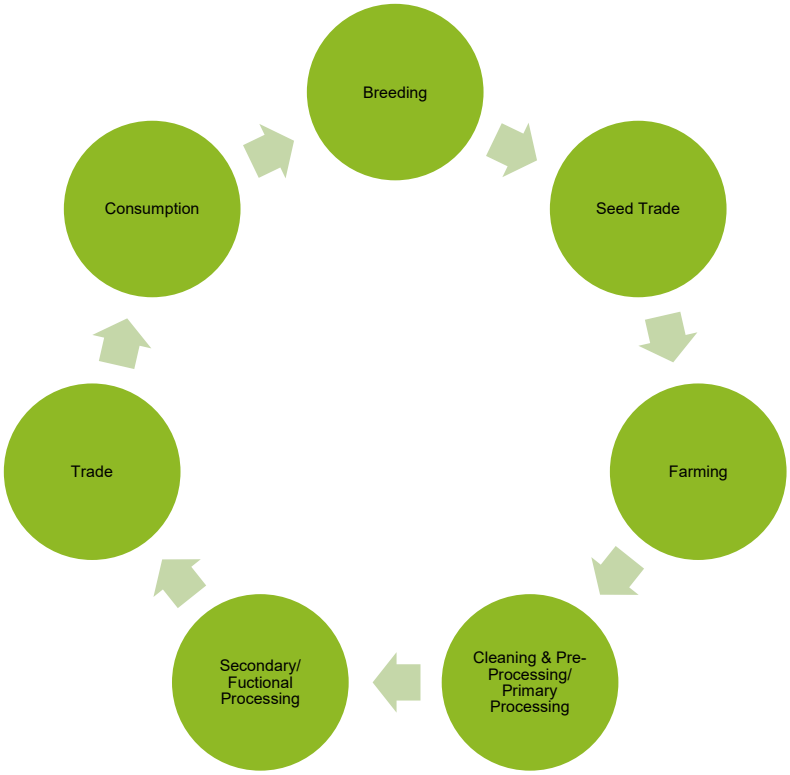

Figure 1 Schematic description of a grain legume value chain, own diagram

Figure 2 Official Logo, Eiwitboeren van Nederland

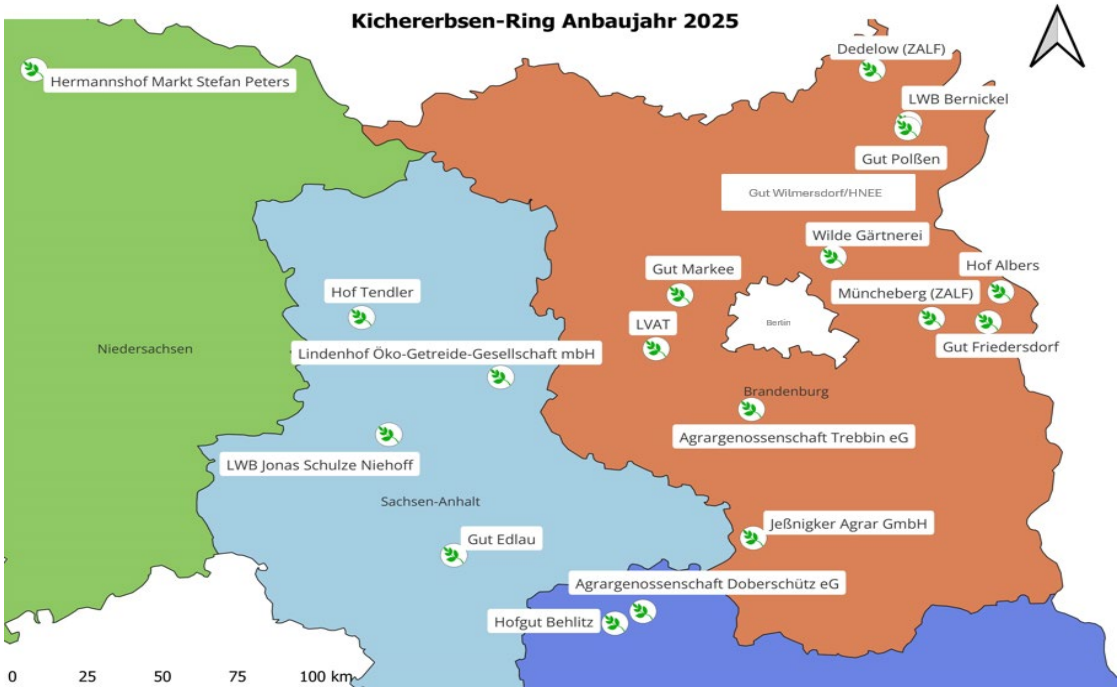

Figure 3 The involved farms and research institutions in "Kichererbsen-Ring", Marvin Teschner

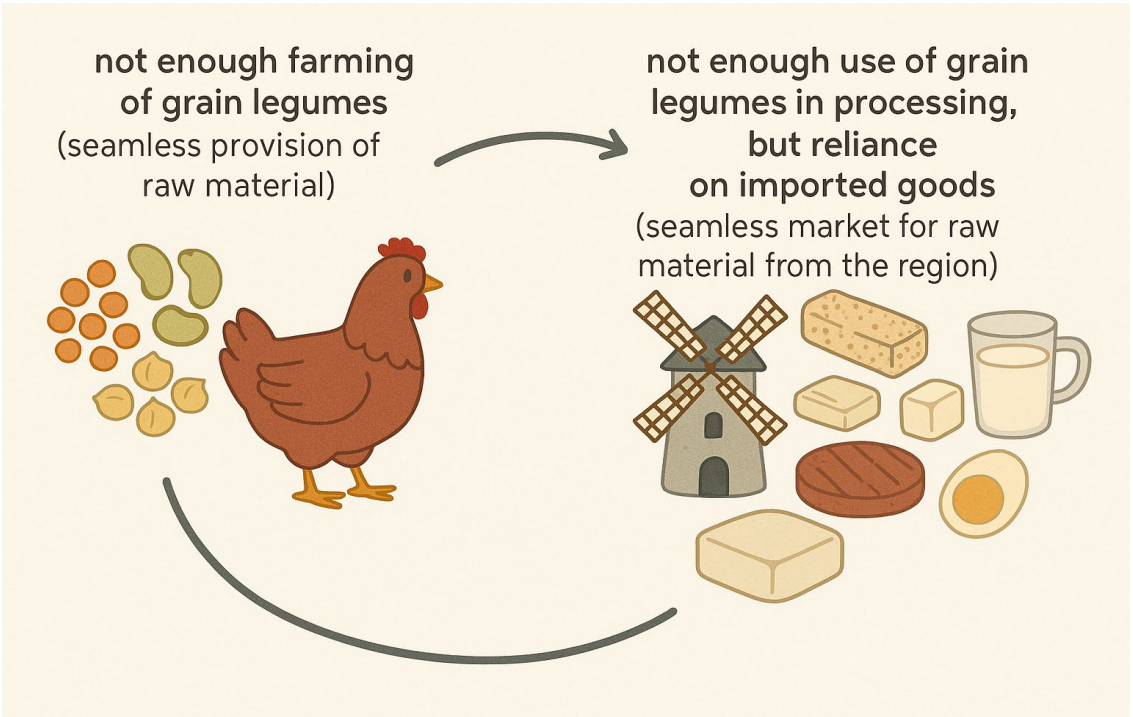

Figure 4 The grain legume "chicken and egg" dilemma of creating regional value chains, generated using ChatGPT (15.05.2025)

Figure 6 Examples of the logo from 'Eiwitboeren van Nederland" in practice

Figure 7 A Wünsch dir Mahl,KIWERTa, Gut Friedersdorf Collaboration: Brandenburger Kichererbsen-Topf/ Soup made with chickpeas from the region of Brandenburg: https://www.ecoinform.de/Brandenburger-Kichererbsentopf-380g.Detail;319063.html

Figure 8 Logo of the project KIWERTa that was put on certain products for communication https://www.kichererbse-brandenburg.de/

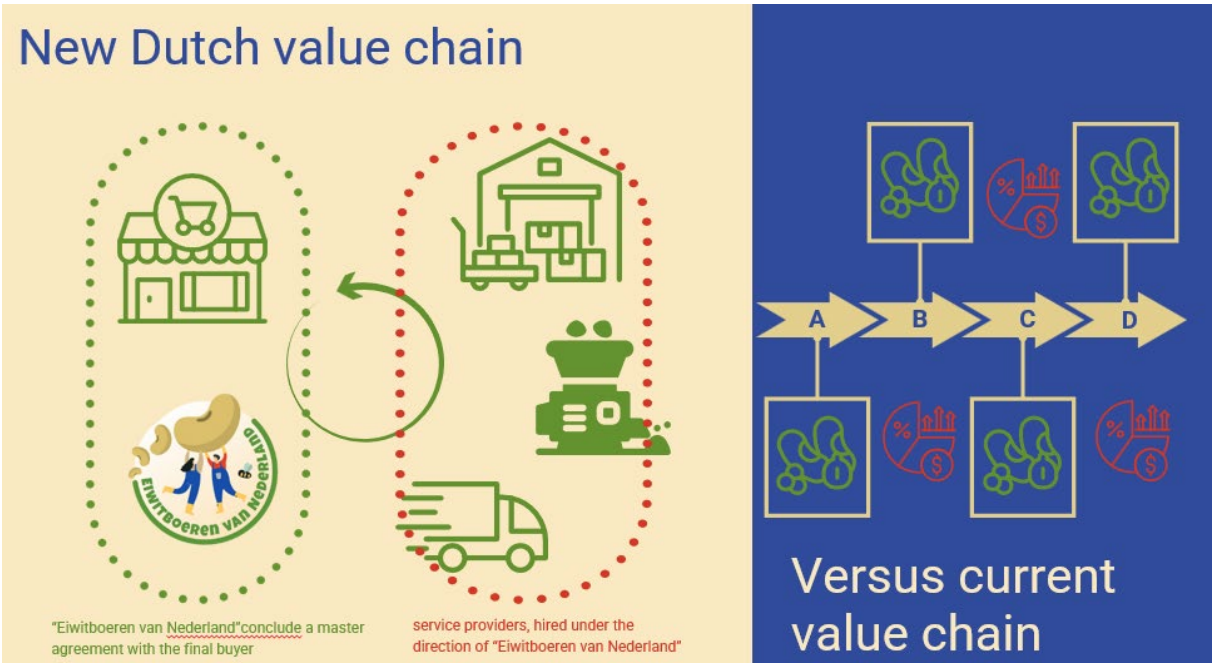

Figure 9 visualisation of the new value chain proposed by the "Eiwitboeren van Nederland" versus the current value chain, where the product changes owner multiple times across the value chain in the Netherlands.

Key aspects	CS 1: "Eiwitboeren van Nederland"	CS 2: "Kichererbsen-Ring"	CS 3: Protein market network
Initial funding	Private source	Public source	
Perpetuation	Secured through membership model and private support	Publicly funded project-chain; In Process	In Process
Enablement of Peer-to Peer Learning	Amongst farmers and value chain actors		
Involvement of Science	Sustainability assessment; Input for agronomic aspects	Through participatory on-farm research and agronomy	In study of bioeconomic side-streams
Choice of involved actors	Forward-looking, open-minded, innovative, open to risks and experiments, with commitment and drive to turn challenges into opportunities, open for collective solutions; independent of size		
Adressed Challenges	• Lack of wide-spread farming knowledge • Lack of medium-sized, flexible, decentralized (regional) primary processing infrastructure • Protein gap: Making regional grain legume cultivation economical for involved actors • Lack of value chains for regional side-streams		
Adressed value chains	Industrial Primary[1] & secondary[2] processing Small to medium size (Start-ups)	Primary & secondary processing Small to medium size (Start-ups)	Secondary & functional[3] processing Industrial - high throughput
Initiator for choice of crops	Combination of farmer's choice, agronomic adaptability to region and market demand		According to consumer acceptance and established processes in industry
Narrative	Farmer driven; System transformation of farmer's position within value chains (Degrowth - needs based)		Structural alignment of value chain actors - Systemic efficiency driven
Communication strategies	Network involved in consumer-addressed communication (i.e. logo)		Consumer-communication delegated to involved industry partners
	Combination of confidential and public exchanges		

Figure 10 Summary of the key aspects in comparison between the three case studies

1 Primary processing: sorting, drying, cleaning

2 Secondary processing: cooking, shaping, fermenting

3 Intermediate/functional processing: extracting, isolating, formulating

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