

# Sector study alternative protein for animal feed landscape in the Netherlands

*For* Netherlands Enterprise Agency and the TopSector Agri & Food

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# Introduction





# Introduction

The Netherlands has a highly developed and competitive agri-food sector. Its strength lies in its innovative character, intersectoral collaboration and international perspective. As such, Dutch organisations are well-positioned to contribute to the global protein shift through developing and commercialising innovative and sustainable solutions, including alternative and more sustainable ingredients for animal feed (livestock & aquaculture).

## Background

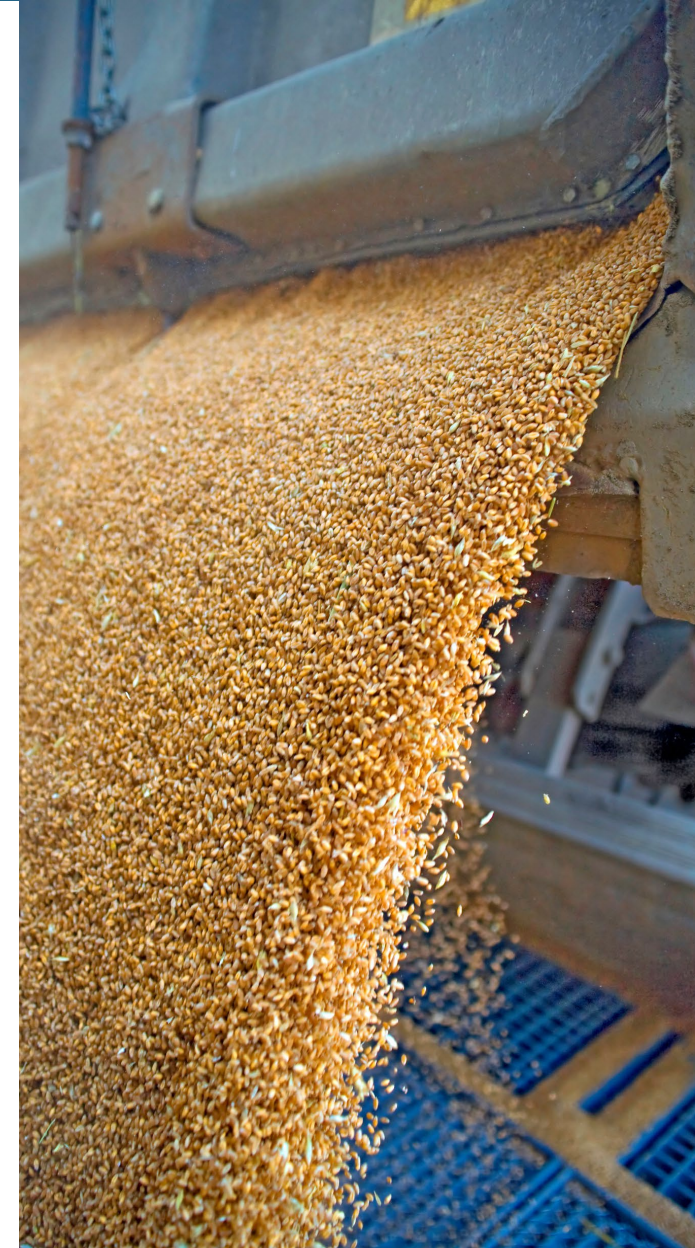
The **Netherlands Enterprise Agency** (hereinafter referred to as the “NEA”) and the **TopSector Agri & Food** (hereinafter referred to as the “TopSector”) would like to have a thorough understanding of the Dutch landscape of parties active in the field of alternative feed ingredients for animal feed, their international ambitions and the challenges they face when entering and expanding their business internationally. Results should provide the NEA and the TopSector insights in the strengths and weaknesses of the Dutch ecosystem and which product-market combinations should be prioritised for future promotion and potential public-private interventions in the areas of international trade, innovation and investment.

**Larive International B.V.** (hereinafter referred to as “Larive”), founded in 1975 and headquartered in the Netherlands, is a business development advisory firm specialised in assisting companies in developing and implementing their market entry or expansion strategies in(to) high-growth markets. Larive is the parent of the Larive Group, a license-based network with exclusive members in 24 countries throughout Asia, Central and Eastern Europe, Turkey and Sub-Saharan Africa. Larive’s services include providing market and business intelligence, developing market entry & growth strategies and strategy implementation.

The NEA and the TopSector engaged Larive to conduct a study on the Dutch landscape for alternative or more sustainable ingredients for animal feed. The analysis has been completed on a ‘best effort’ basis through desk research and qualitative research, including a vast number of in-depth interviews with private sector players and public stakeholders (policy makers, business associations, educational institutes). This study has been conducted between May and September 2023.

## Objective

This report provides a comprehensive overview of the Dutch players **active in the field of** alternative and more sustainable ingredients for animal feed, including their product-service offerings, locations, partnerships/alliances, current international activities and positioning, as well as their international ambitions and perceived bottlenecks to accelerate international growth. Additionally, the report features a SWOT analysis of the Dutch ecosystem in this field, including an overview of the most attractive markets/regions for international growth in terms of trade, innovation, and investment.





# Introduction (cont.)

## Method

In this report, the current state and prospects of alternative protein sources for animal feed in the Netherlands is analysed. Also, the different stakeholders involved in the development and implementation of these sources are included. The report discusses opportunities and challenges faced by the value chain, divided into clusters, as well as interactions and collaborations within and over the clusters. Finally, the report provides recommendations and suggestions for further research and opportunities.

## Value chain analysis

For this report, the Dutch value chain is categorised along different clusters which, combined represent the 'Dutch Diamond'. The Dutch Diamond represents all players in the ecosystem for alternative ingredients in the animal feed sector. These clusters contribute the development and availability of the alternative protein sector along six categories: safety and regulations, solution providers, ingredient producers, processors and distributors, sector organisations and innovation hubs.

## Analytical framework

The analytical framework employed for assessing the Dutch alternative protein for feed ecosystem is the SWOT analysis. This tool enables a systematic assessment of the ecosystem's internal strengths and weaknesses, against external opportunities and threats. The internal assessment considers factors such as technological capabilities and research expertise. The external assessment considers market demand, regulatory landscape and competitiveness. This combined evaluation facilitates an overarching understanding of its dynamics and potential opportunities for growth.







# Value chain for alternative protein for feed



# The Dutch animal feed sector

## The Feed Sector in the Netherlands: A key player in the protein transition

The feed sector is an important part of the Dutch economy, employing over 20,000 people and producing high-quality feed for various types of livestock. The feed sector is also a major player in the protein transition, which is a policy initiative to make the protein system more sustainable, resilient, and circular. In this chapter, an overview of the feed sector in the Netherlands, its role in the protein transition, its innovation and sustainability efforts, and its future prospects is elaborated on.

### Overview of the feed sector

The feed sector in the Netherlands is projected to grow at a compound annual growth rate (CAGR) of 1.8% to reach EUR 3.5 Bn by 2027. In total, over 200 feed mills are operational, with poultry feed leading the market share, followed by pig and cattle feed. The sector is highly concentrated, with the top-10 feed companies accounting for 70% of the market. Furthermore, the sector is much export-oriented, as over 50% of the feed produced is exported. The sector processes approximately 12 Mn MT of raw materials annually.

The Netherlands is dependent on imports for about 80 percent of its plant-based protein needs, mainly soybeans from Brazil and the United States. This is similar to the EU average, which relies on imports for about 75 percent of its plant-based protein needs.

### The Role of the feed sector in the protein transition

The animal feed sector plays a crucial role in the transition towards a more sustainable and circular food system, as described in the National Protein Strategy (NPS). This strategy aims to reduce the reliance on protein imports (such as soy) from outside the European Union and to increase the production and utilisation of new and plant-based proteins. This contributes to reducing the ecological footprint of animal husbandry, creating shorter supply chains with sustainably produced ingredients for animal feed, and freeing up more land for food production. The NPS aligns with the Vision of the Ministry of Agriculture, Nature, and Food Quality and the European Green Deal, both of which aim to achieve a healthy balance between agriculture, nature, and climate.

## Innovation and Sustainability in the feed sector

The Netherlands is at the forefront of technological advancements, driving innovation in new feed technologies. With a clear focus on feed efficiency and cost-driven perspective, the feed sector embraces advanced innovative scalable techniques to optimise availability and sustainability. The sector actively explores alternative ingredients such as insect-based proteins, microalgae, and co-products from former food stuffs. For example, currently, insect meal production for animal feed exceeds 40,000 MT annually. With the scalable industrial insect production solutions of Dutch players, this volume will increase in the Netherlands and the rest of Europe.

Moreover, circular economy practices, including the utilisation of co-products and waste streams, play a crucial role in the sector's efforts to minimise waste and environmental impact. The fermentation techniques that are developed are an important driver of the co-product sector.

### The future of the feed sector

The NPS offers the focus points for the Netherlands on protein for the coming years. The NPS aims to increase the self-sufficiency rate of new and existing plant-based proteins in the Netherlands in a sustainable way over the next five to ten years. The NPS focuses on utilising proteins from residual streams, promoting the cultivation of protein-rich crops, investing in research on new protein sources for humans and animals. The NPS aligns with the European ambition to reduce dependence on protein imports and produce more plant-based proteins at the EU level.

The Netherlands is proactively adapting to the protein transition by continuously developing new technologies and solutions to produce more sustainably and circularly with a decreased impact on the environment. Because of this focus, the country is positioning itself as a frontrunner in transferring knowledge and technology worldwide.

The feed sector in the Netherlands has great potential to contribute to the protein transition and to become a global leader in sustainable and innovative animal nutrition. By collaborating with other stakeholders, such as farmers, researchers, policymakers, consumers, and civil society organisations, the feed sector can create a positive impact on both human health and environmental quality.



# The Dutch animal feed sector (cont.)

## Developments the past century

The past decades the Dutch feed sector has undergone various changes in sourcing strategies for proteins for feed. These developments have been instrumental in shaping the sector's focus on alternative protein sources. In the 1960s and 1970s, the Dutch feed sector emerged as a solution to the problem of disposing of residual materials from the food processing industry, which was booming in the Netherlands. The sector established a co-operative organisation, the 'Product Board Animal Feed' (*Productschap Diervoeder*, PDV), which regulated the quality and safety of animal feeds and raw materials.

In the 1980s and 1990s, the Dutch feed sector adopted innovative technologies, such as drying machines to valorise co-products from the food industry and incorporate them into animal feed formulations. This marked a shift from waste management to resource optimisation, as well as a diversification of feed ingredients. The unique geographical proximity of food processors and livestock sectors resulted in highly efficient valorisation of co-products ('Moerman's ladder').

The past years, the Dutch feed sector faced new challenges, such as economies of scale, decrease of the livestock population and the environmental concerns related to deforestation and greenhouse gas emissions. The sector responded by developing new processes, such as co-fermentation and bioethanol production, to enhance the nutritional value and sustainability of animal feed. The sector also witnessed the emergence of startups focusing on solutions and production of alternative protein sources, such as insects, algae and plant-based proteins.

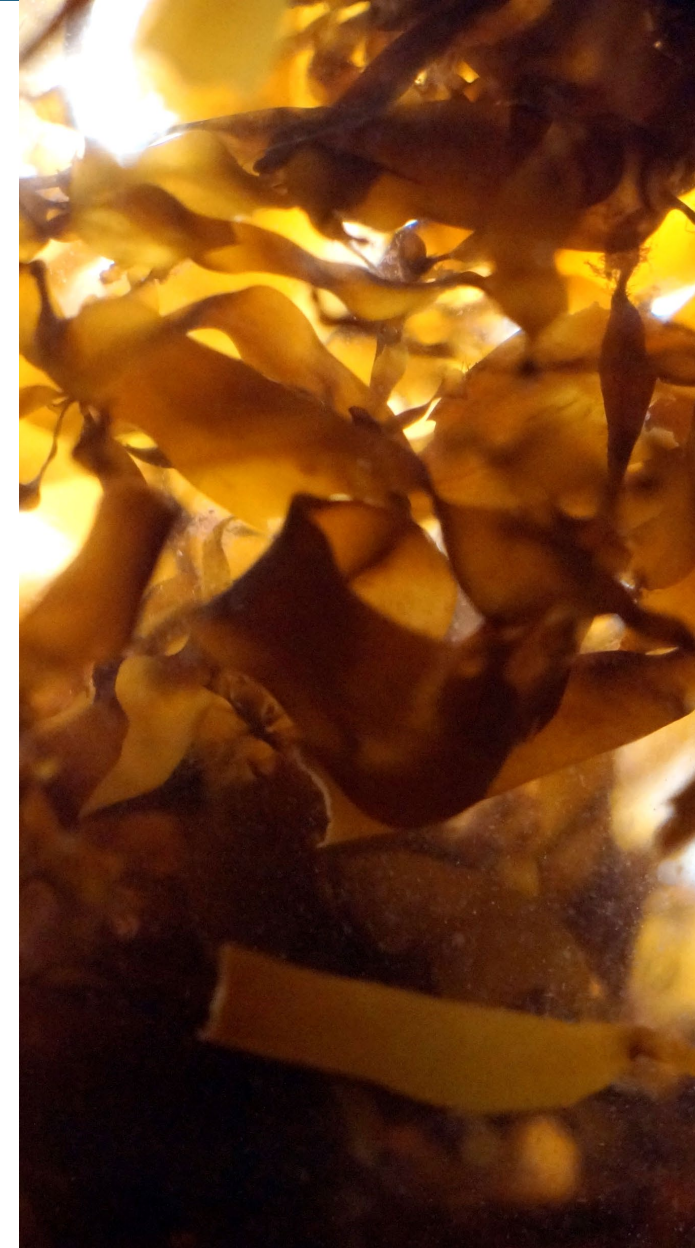
Moreover, the sector had to adapt to the changing dynamics of the Dutch farming industry, which saw a decrease in the number of farms but an increase in the volume of production per farm. A trend was also observed that large scale farmers were seeking to grow and to buy ingredients directly as feed, bypassing the feed sector.

The sector continues its journey of innovation and sustainability, driven by consumer preferences, regulatory frameworks, and technological advancements. The sector explores opportunities for circularity, biorefinery, digitalisation, as well as new markets.

## Current challenges

The Dutch feed sector plays a key role in the protein transition. However, the sector also faces several challenges in achieving this goal, such as balancing production and sustainability and meeting consumer demand.

The feed millers have to increase production capacity (due to international demand) and efficiency, while reducing its environmental impact and dependency on imported protein sources. The sector also deals with competition from other countries that have lower production costs. Moreover, the sector has to respond to the consumer preferences for animal protein, which may vary depending on factors such as health, price, and ethics.



# Alternative protein for animal feed

Despite these challenges, the sector has shown resilience and innovation in addressing them. The sector invests in R&D to reduce environmental impact and enhance sustainability. For example, the sector explores the production of alternative protein sources such as insects, algae, and co-products from former foodstuffs.

In addition, almost 95% of the compound feed produced in the Netherlands is certified under recognised sustainability schemes, such as GMP+ and VLOG, ensuring responsible sourcing and production practices. Moreover, the feed sector strictly adheres to rigorous quality control measures, with regular sampling and testing for contaminants, pathogens, and nutrients to ensure compliance with safety and nutritional standards.

International collaboration is integral to the Dutch feed sector's growth and development. Stakeholders, including feed manufacturers, research institutions, industry associations, and governmental bodies, foster collaboration through knowledge sharing, joint research projects, and initiatives aimed at addressing common challenges. This collaborative approach ensures continuous improvement and a prosperous future for the Dutch feed sector.

In conclusion, the Dutch feed sector faces various challenges in relation to the protein transition, but it also demonstrates its potential and capacity to overcome them. The next paragraph will discuss the opportunities and prospects of the Dutch feed sector in the future.

## Alternative proteins

One of the main trends is finding alternative protein sources that can replace or reduce the reliance on soybean, the most common protein source for all compounded feeds for poultry, dairy cattle and pigs. Soybean cultivation has been associated with various environmental and social issues, such as deforestation, biodiversity loss, greenhouse gas emissions and pesticide use. Hence, there is a growing interest in exploring alternative protein sources that provide adequate nutrition for animals while minimising environmental impact through the establishment of shorter supply chains and circular solutions.

Some of the emerging alternative protein sources and production technologies for animal feed include (techniques for) insects, seaweed and microalgae, earthworms, single-cell proteins and co-products utilisation. These techniques and sources have various advantages over conventional protein sources, such as local and regional production possibilities, diverse amino acid profiles, low land and water requirements, low greenhouse gas emissions, and potential animal health benefits. However, there are also some challenges to adoption, such as regulatory issues, farmer acceptance, technical feasibility, scalability, cost-effectiveness and availability.





# Alternative protein for animal feed (cont.)

## Cluster overview

The 'Dutch Diamond' refers to a cluster of actors active in the field of alternative ingredients for the animal feed sector. The cluster can be divided into six compartments: safety and regulations, solution providers, ingredient producers, processors and distributors, sector organisations and innovation hubs.

- 1. Safety and regulations** encompasses regulatory bodies and testing labs responsible for ensuring the safety and compliance of feed and food products. They play a crucial role in establishing and maintaining high standards of safety and quality.
- 2. Solution providers** offer various technologies, logistics, and supply chain solutions to support development and implementation of new solutions.
- 3. Ingredient producers** are producers of alternative protein ingredients, which can be categorised into three groups.
  - I.** Novel ingredients, companies in this category focus on developing and producing innovative and unconventional protein sources for animal feed.
  - II.** Upgraded raw materials, companies active in this segment work with traditional raw materials and employ innovative processes to enhance nutritional values resulting in protein as inputs for feed.
  - III.** Co-products, companies in this category utilise by-products or waste streams to create valuable animal feed ingredients.
- 4. Feed producers and distributors** include large Feed producers and distributors who play a central role in the sector. These organisations handle the processing, manufacturing, and distribution of final animal feed products, ensuring their availability and accessibility to farmers and livestock producers.
- 5. Sector organisations** are industry associations or trade groups that represent the collective interests of the sector. They work towards promoting collaboration, advocating for favourable policies, and facilitating knowledge sharing and networking opportunities within the industry.
- 6. Innovation hubs** are catalysts for fostering innovation and testing new products. These hubs provide a supportive environment, resources, and expertise to encourage research, development, and the introduction of ideas and technologies.

By examining the Dutch Diamond, the report aims to provide a comprehensive analysis of the strengths, weaknesses, opportunities and threats within the Dutch ecosystem for alternative feed ingredients. The report also aims to map how the sector approaches the protein transition, the state of play and the challenges it faces. The next slide provides the overview of the identified Dutch alternative protein landscape for animal feed and its value chain players.







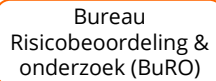
# Overview Dutch Diamond





# Dutch Diamond | Examples of actors active in the field of alternative protein for animal feed in the Netherlands

## 5. Safety & regulations



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## 4. Innovation hubs



## 1. Solution providers



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## 2. Ingredients producers



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## 3. Processors & distributors



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## 6. Sector organisations



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# Dutch Diamond: Examples of solution providers

## Ecosystem

- 1. BRS Biorefinery solutions
- 2. FBFeeds BV
- 3. Insect.Systems
- 4. Lgem
- 5. Loop
- 6. Marel
- 7. Mavitec
- 8. Multiphase dryers
- 9. Novades
- 10. Raven Feeds
- 11. Rinus & Hans
- 12. Smits
- 13. VDL Insect Systems
- 14. Zetadec

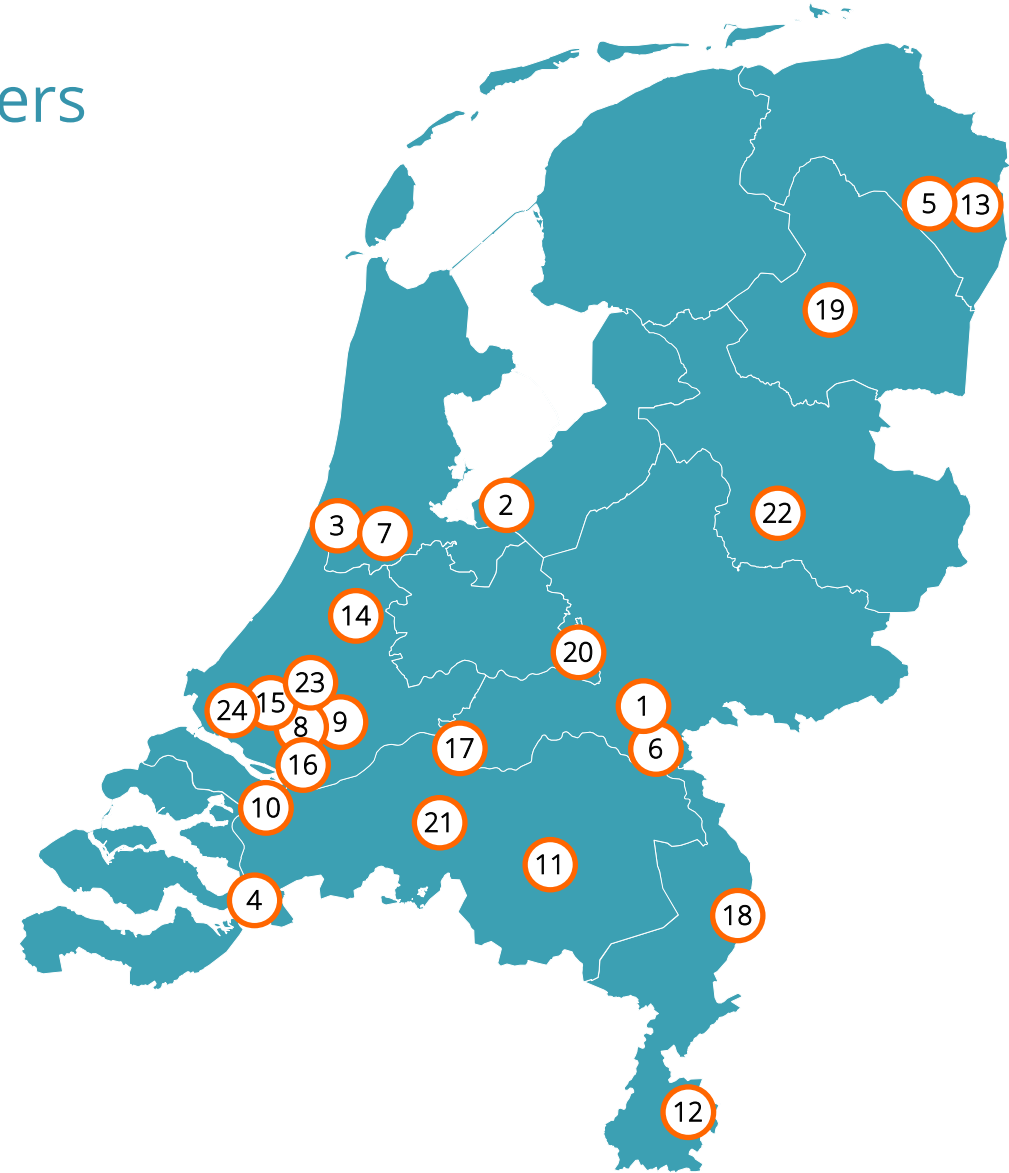




# Dutch Diamond: Examples of ingredient producers

## Ecosystem

- |                          |                         |
|--------------------------|-------------------------|
| 1. AlgaeHolland          | 17. Feedvalid           |
| 2. AlgaSpring            | 18. GRASSA              |
| 3. Amusca                | 19. Noblesse Proteins   |
| 4. Azolem                | 20. Phycom              |
| 5. Avebe                 | 21. Protix              |
| 6. BambooLogic           | 22. Rubisco             |
| 7. Barentz Raw Materials | 23. The seaweed company |
| 8. Cefetra Feed Service  | 24. Veramaris           |
| 9. Codrico Rotterdam     |                         |
| 10. Cosun Beet Company   |                         |
| 11. Darling Ingredients  |                         |
| 12. DSM                  |                         |
| 13. Dunagro Hemp Group   |                         |
| 14. Duynie               |                         |
| 15. EntoGourmet          |                         |
| 16. EVRI Ingredients     |                         |



# Dutch Diamond: Examples of processors

## Ecosystem

1. Agrifirm Group
2. AR Agruniek Rijnvallei
3. Bonda
4. Co-producten AR
5. De Heus
6. Denkavit
7. ForFarmers
8. Hepromij
9. Looop
10. Nijsen
11. Nutreco
12. Provimi
13. TopFeed
14. van Triest
15. Voerwaarts circulair





# Dutch Diamond: Examples of innovation hubs, safety & regulations and sector organisations

## Innovation hubs

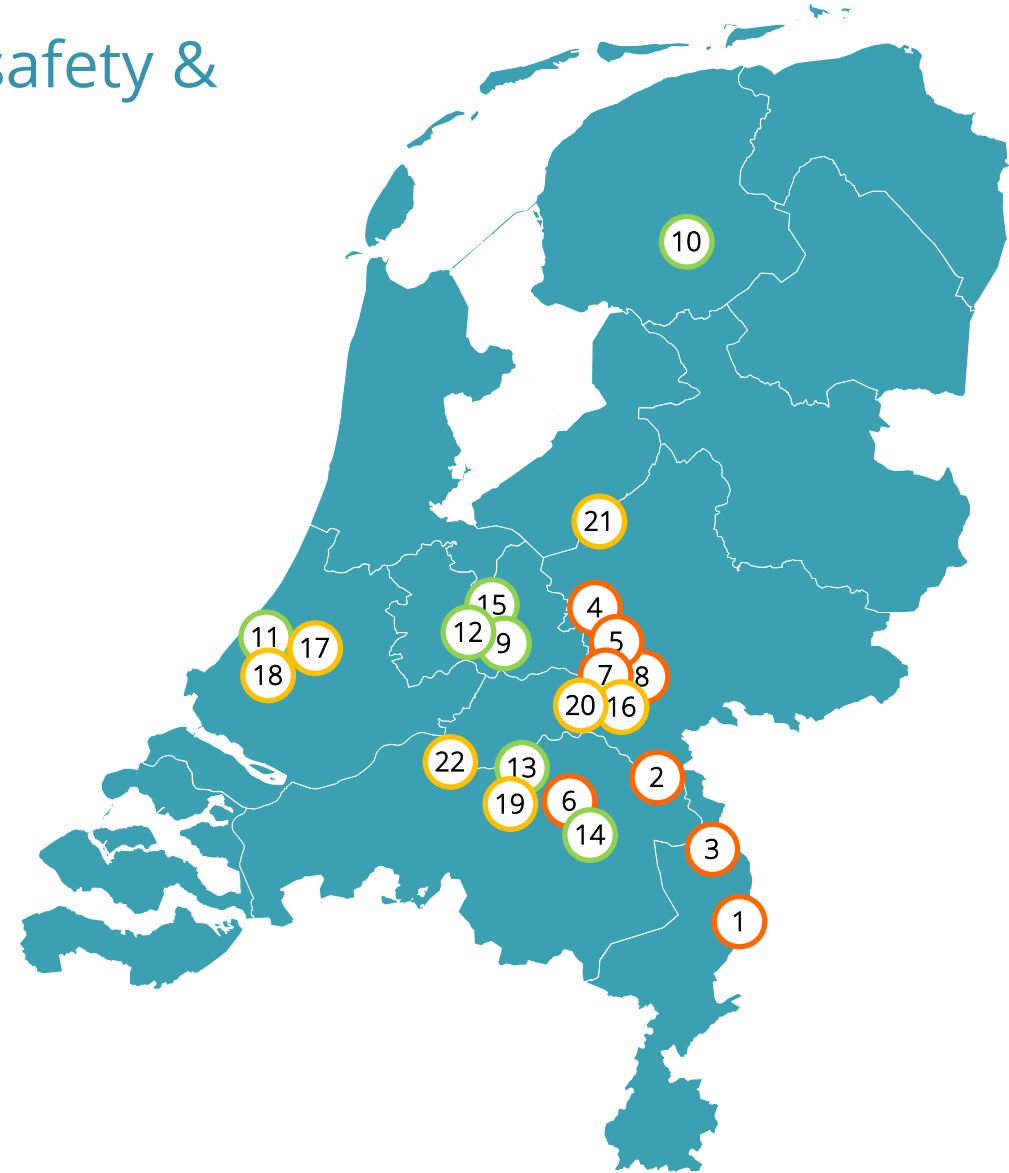
1. Brightlands Campus Greenport Venlo
2. Eiwit Campus Beers facility
3. Feed Design Lab
4. Insect Experience Centre
5. Network for Insect Knowledge (NIK)
6. Smart Farm Pigs and Poultry Laverdonk
7. StartLife
8. Wageningen University & Research (WUR)

## Safety & regulation

9. Bureau Risicobeoordeling en onderzoek (BuRO)
10. Eurofins
11. GMP+ International
12. Nederlandse Voedsel- en Warenautoriteit
13. Normec Foodcare
14. Nutricontrol
15. Rijksinstituut voor Volksgezondheid en Milieu

## Sector organisation

16. FoodValley
17. MVO ketenorganisatie
18. Nevedi
19. NGN
20. ProteinCommunity
21. VENIK
22. Voedingsmiddelen In Diervoeder Overleg (VIDO)



A small, dark fly is positioned on a light-colored, textured surface, possibly a piece of paper or fabric. The fly is facing upwards and is the central focus of the upper portion of the slide.

# Dutch Diamond – Solution providers



# Solution providers

In the Dutch alternative protein feed sector, there are several solution providers that offer technologies, logistics, and supply chain solutions to support the development and implementation of new solutions. Overall, these companies do not produce the proteins themselves, but play a role by providing infrastructure, research capabilities and resources needed to bring (new) products to market. Solution providers contribute to advancement of efficiency and scalability of production and enable scalability and accessibility of alternative protein ingredients. The cluster 'solution providers' is divided into two types: the ones providing and developing equipment and technology for protein production and the ones optimising transportation, storage, and distribution of alternative protein feed ingredients.

## 1. Technology providers

Technology providers focus on developing and supplying systems and equipment for alternative protein production. They offer innovative technologies and solutions that enable the cultivation, processing, and extraction of proteins from various sources. In the Dutch alternative protein feed sector, technology providers specialise in areas such as insect production (Insect.Systems, Ravenfeed), algae production (BRS Biorefinery solutions, Lgem, Rinus & Hans), rendering equipment (Mavitec, Marel) and more practical applications to the drying of co-products (Multiphase dryers).

Take, for instance, the realm of insect production, where technology providers engineer comprehensive systems that encompass breeding, rearing, and processing on a substantial scale. These systems may include automated breeding facilities, specialised climate control systems, efficient feeding solutions, and insect harvesting and processing equipment.

Similarly, in the field of algae production, specialised equipment is designed to cultivate and extract proteins from algae, often featuring specialised photobioreactors, nutrient delivery systems, and advanced harvesting technologies. Lgem, for example, is a technology provider designing, installing and operations patented photobioreactors (PBRs) for microalgae cultivation for instance for AlgaPrime DHA, a joint venture between global giants Corbion and Bunge.

Another example is Mavitec, a technology provider specialising in rendering animal co-products, former foodstuff processing, and manure gasification. Headquartered in Heerhugowaard, Mavitec's global reach is amplified through their sales and service offices, as well as a network of representatives. Mavitec leads the specialised industry of animal by-product transformation. They anticipate on market trends, such as optimising co-product materials and rising meat consumption worldwide, positioning themselves at the forefront of the evolving landscape. Collaborations, like those with Amusca, an ingredient producer, drive their innovations in insect farming and feed production.

In addition to the equipment technology, there are also companies such as FBFeed that provide technical solutions related to the development and production of protein ingredients for animal feed.



# Solution providers (cont.)

## 2. Supply chain or logistics solution providers

Supply chain or logistics solution providers focus on optimising collection, transportation, storage, and distribution of alternative protein feed ingredients. They offer services and solutions that ensure efficient logistics or supply chains for example, from the point of production to end-users, such as farmers and feed manufacturers (Loop, Novades, Smits). These solution providers may handle aspects such as storage, packaging and transportation and streamline supply chains. Supply chain or logistics solution providers play a vital role in enabling the scalability and accessibility of alternative protein feed ingredients. They help bridge the gap between production and end-use by ensuring a smooth and reliable supply chain (Zetadec).

An example is, Loop, active as a logistic solution provider and processor with a circular approach. Specialising in the valorisation of organic rest streams, Loop transports and transforms co-products into inputs. Their distinctive off-take guarantee and collaborative partnerships ensure no resource goes unused, reflecting a commitment to circularity. Loop provides a service to food production companies, effectively relieving production firms of the responsibility by overseeing their waste streams. With a strategic hub in Venlo, Loop efficiently manages a substantial production capacity and daily shipments, showcasing their logistics expertise. As they innovate and collaborate with circular economy startups, Loop exemplifies sustainable growth while overcoming challenges such as sourcing amid the rise demand for by-products for other applications. As a logistic solution provider, Loop contributes significantly to the sector's drive for efficiency and circularity.

Moreover, Novades is a company that transforms every residual stream of raw material from food producers into feed ingredients. These are then sold to Feed producers who can benefit from Novades' advanced software that offers full traceability for the residual streams.

Another supply chain solution provider is the Smits Groep, the company has an integrated circular supply chain within their group, starting from the recycling department where waste streams of food are collected. Accordingly, the usable waste streams are processed for their own pig farm and the waste stream that is not suitable for the animal is fermented into biogas.

Overall, both technology providers and supply chain/logistics solution providers are essential for the development and implementation of new solutions. While technology providers focus on developing the necessary systems and equipment for production, supply chain or logistics solution providers optimise the transportation and distribution streams of alternative protein feed ingredients, ensuring their availability to the market.







# Dutch Diamond – Ingredient producers and providers

# Ingredient producers and providers

In the Dutch feed sector, a multitude of ingredient producers are focussed on producing protein-rich ingredients to replace conventional proteins. The search involves a diverse range of ingredient producers, encompassing both innovative and more traditional sources for protein. The pursuit of sustainable and environmentally friendly ingredients has spurred a significant upsurge the number of players active in alternative proteins for the feed, agricultural and livestock sectors. In the face of challenges confronted by conventional feed sources, such as resource scarcity, environmental implications and ethical considerations, the Netherlands has emerged as a forerunner of innovation, playing a central role in cultivating ingredients with a focus on alternative proteins for animal feed.

The players in this cluster have various overlapping characteristics. One, a sustainability focus, they aim to reduce the environmental impact. For example, Bamboologic Europe produces bamboo, a fast-growing and renewable source of protein. Two, an innovation focus, they explore new sources of protein such as algae, insects, and microorganisms. Three, a circular economy approach, they repurpose co-products from various industries to create valuable ingredients, minimising waste and promoting efficient resource utilisation. For example, Duynie, FeedValid and Noblesse Proteins are some companies that adopt this. Four, advanced processing methods, they upgrade nutritional value and sustainability of traditional feed ingredients through innovations and technologies. These characteristics reflect the vision and values of the Dutch alternative protein for feed sector, a dynamic and diverse cluster of companies that offer high-quality and eco-friendly solutions for animal feed.

This chapter explores the landscape of ingredient producers in the Netherlands, classifying them into four distinct segments: novels, co-products, raw materials upgrade and distributors.

## 1. Novels

The segment for novels comprises companies at the forefront of pioneering and exploring innovative sources of protein as feed ingredient. These companies are driven by a commitment to finding sustainable, alternative protein sources that can replace or complement conventional protein. Different categories are insects, seaweed and microalgae, single cell proteins and earthworms.

## 2. Co-products

Companies, such as Duynie, FeedValid, and Noblesse Proteins specialise in utilising co-products from various industries to produce feed ingredients. By repurposing and transforming co-products into valuable feed components, these producers contribute to a circular economy and sustainable feed production. There categories within this segment are direct co-products and processed co-products.

## 3. Raw materials upgrade

The raw materials upgrade segment comprises companies like Avebe, Bamboologic, Codrico, Cosun, Dunagro, and Grassa. These ingredient producers concentrate on upgrading nutritional value and sustainability of conventional ingredients through advanced processing methods and innovative approaches.

## 4. Distributors

Barentz Raw Materials, EVRI and Loop are players in the distribution segment, connecting ingredient producers with feed manufacturers and end-users, such as farmers directly. Their role in the supply chain facilitates the availability and accessibility of alternative protein ingredients to meet demands.



# Ingredient producers and providers - novels

The segment for novels are 'new' sources being explored as protein ingredients. These sources include insects, seaweed, microalgae, and single-cell protein.

## Insects

Insects are rich in protein, containing up to 82%, with a variety of amino acids. They serve as highly efficient sources of protein per unit of land, requires less water, feed and space compared to conventional sources. In addition to their protein content, insects offer health advantages due to their fatty acid composition and antimicrobial peptides. Many livestock species, particularly chicken and fish, have a natural preference to consume insects. The inclusion of edible insects into animal feed not only delivers high nutritional value and efficient feed conversion, but it also supports environmentally sustainable animal nutrition.

The Netherlands is a global leader in terms of insect breeding. With production steadily increasing and demand on the rise, the scientific community, government authorities and other stakeholders are fully engaged and fostering innovation. The Dutch insect segment has a vision to foster support and encourage the further development of the insect chain, by addressing the challenges and opportunities in terms of research, innovation, legislation and education. The Dutch Council on Animal Affairs (RDA) has also investigated the social values and ethical implications of insect production, such as animal welfare, public health, biodiversity and cultural acceptance. The Dutch insect industry, companies such as Protix and Amusca aim to create a sector that can contribute to circular agriculture and food security.

The insect industry also faces some barriers and gaps that need to be overcome. One of them is the high cost of breeding insects (production), which makes them more suitable for pet food than for livestock feed, as the former has higher margins. However, the current production volumes of insect in the Netherlands is too large, causing the niche pet food market to be less too competitive for insect producers.

There is also a challenge in the development of the production processes. On one side, there are companies that produce completely manually, which is very cost intensive due to human resources. On the other side, there are companies that are completely automated, leading to too high-tech intensive investments. This in combination with the energy crisis, namely, the fact that almost all insects bred in the Netherlands are tropical or subtropical breeds and therefore require a warm environment, make some companies struggle to survive. There is a need for development of the middle ground, where companies can find a balance between manual and automated processes.

An interesting fact to mention is that a lot of the mealworms produced in the Netherlands are exported to France. This is because France has invested heavily in insect farming, supported by the state. France is ahead of other countries in terms of investments in this sector.

A positive development for the insect industry is the recent risk analysis by the Dutch Food and Consumer Product Safety Authority (NVWA) on the use of animal co-products in insect breeding. They concluded that this practice does not pose a threat to food safety and encouraged further research on this topic. This could open-up new possibilities for using waste streams as feed for insects, reducing costs and increasing circularity.



# Ingredient producers and providers – novels (cont.)

## Seaweed, algae and microalgae

Marine plants have proven effective in substantially reducing methane emissions from livestock production. Even a small amount of seaweed added to cattle feed can lower methane production by 98%. Given the substantial global cattle population, seaweed's impact on methane emissions could be significant. Next to emission reduction, these marine plants also offer bioactive compounds that enhance animal health and production. In the Netherlands, companies such as Phycom, Algae Holland, Rubisco, AlgaeSpring, and Azolem are actively involved in seaweed and microalgae-related production.

## Single-cell protein

Single-cell proteins are proteins produced through fermentation from microorganisms like yeast, bacteria, fungi, and algae. These microorganisms can utilize inputs such as carbon dioxide, hydrogen, and oxygen to grow. This enables manufacturers to make use of waste streams from non-food sectors. For instance, carbon dioxide emitted by cement factories can be harnessed to cultivate single-cell protein. By combining fermentation technology with readily available waste streams, it becomes feasible to generate protein with proximity to the market, thus avoiding geographical limitations. This addresses the challenge of shipping protein sources worldwide, similar to the current practice with soy protein.

This innovative concept of single-cell protein production diverges from the conventional method of deriving protein from agricultural sources. The customary approach to obtaining protein involves sources like plant-based protein, aquaculture, poultry, and livestock. This is the familiar protein concept. The novel approach involves deriving proteins from microorganisms and waste streams, without relying on agricultural resources. This novel concept gains awareness within the feed industry. An essential consideration for single-cell protein for the feed sector is achieving cost-effectiveness in production to facilitate market scalability.

The application of single-cell protein introduces value to the future protein landscape, showing promise for novel approaches to animal feed. Diets centered around single-cell protein offer a sustainable and renewable alternative in feed composition. When combined with single-cell omega-3 fats from Veramaris, this approach reduces dependence on fishmeal for aquaculture feed. Notably, in the Netherlands, DSM is leading the Smart Protein project, actively exploring and capitalising on the fermentation of single-cell protein providing proteins for the feed industry.





# Ingredient producers and providers – novels (cont.)

## Earthworms

Earthworms are emerging as a valuable component in aquaculture feed due to their protein levels, essential amino acids and lipid composition, like fishmeal. Research indicates that red earthworms enhances fish growth, reproductive performance, feed digestibility, stress reduction and survival rates. Though further research is necessary for commercial production, the potential of sustainably replacing conventional animal and plant protein sources in aquaculture feed, while promoting fish growth, is promising. While no Dutch companies are currently engaged in utilising these ingredients, the evolving landscape holds the prospect of change as research and innovation in this field continue to unfold.

## Mealworms

Mealworms are the larval stage of the *Tenebrio molitor* beetle, and are rich in protein, vitamins and amino acids. It can be used as an alternative source of animal feed for monogastric and ruminant animals, such as chickens, pigs, and cows. Mealworms can be reared using local agricultural co-products, such as oat-based or wheat-based substrates and have lower environmental impacts compared to conventional livestock. In the Netherlands, there are several initiatives to promote the use of mealworms and other insects as animal feed, such as the PROteINSECT project, the InsectPoint platform, and the Insect Valley Europe initiative.

The PROteINSECT project, which was funded by the EU and involved Dutch partners such as Wageningen University and Research Centre (WUR) and Protix. The project aimed to demonstrate the safety and quality of insect protein for animal feed and to develop guidelines and standards for insect production and processing.



# Ingredient producers and providers - co-products

The co-product for animal feed ingredients segment in the Netherlands has flourished due to the synergy between the country's food and beverage production and its robust livestock industry. Co-products from food and beverage production are integrated into an efficient value chain that connects to the livestock sector. A vital element of this process is streamlining the supply chain efficiency, to avoid unnecessary costs, thereby ensuring the sustainability of business operations. A significant portion of these products consists of approximately 70% water content, necessitating a delicate balance between nutritional and economic factors. Leading players in the co-product domain include Bonda, Duynie, Feedvalid, Looop, Nijsen, and Noblesse. Each of these companies focuses on a unique selling proposition (USP). For instance, Bonda excels in producing co-products for liquid compound feed, while Looop's forte lies in adept supply chain management, boasting a fleet of over 70 trucks that efficiently serve Northern Europe. On the other hand, Nijsen, specialises in processing bakery co-products at their facility, while collecting bakery co-products from Norway to Italy.

The European pig sector consumes 45 Mn MT of feed per year, of which 25% are co-products. Co-products are the residuals of other agricultural or industrial processes that can be used as feed ingredients for pigs. The pig sector plays an important role in processing these co-products and reducing waste. However, the LBV-plus policies and the human protein transition towards plant-based protein consumption could create a surplus of (liquid) co-product. This could lead to a shift of co-product use from animal feed to bioenergy, especially bioethanol, due to the heavy subsidies and competitive prices in the bioenergy sector.

Given the daily decision-making between economic and nutritional priorities for the co-products, companies are presented with two supply options: direct transport to livestock farms or processing to animal feed. This distinction separates direct animal feed and processed animal feed. Direct transport means using co-products as they are, without any further treatment and transporting them directly to end-users. Processing means adding value to co-products by enhancing their quality, safety, nutritional values or shelf-life. Bonda, a company that processes or distributes over 65 co-product ingredients, distributes 50% of its co-products through direct transport and 50% through processing.

## Direct animal feed co-products

Direct animal feed co-products often entail high water content, resulting in expensive transportation of the protein content. Additionally, the geographical location plays a role in decision-making, as companies avoid extra costs linked to long-distance transportation. For instance, potato co-products from Avebe in the North of the Netherlands are locally processed rather than transported to southern provinces. Among these co-products, milkmaid stands out for being frequently transported directly to pig farmers. This liquid, derived from the dairy industry, contains substantial protein levels in liquid form.

## Processing to animal feed co-products

Processing co-products for animal feed such as brewers' yeast, wheat yeast concentrate, potato co-products and beet pulp involves collecting the co-products at production facilities. Subsequently, these materials often undergo a drying process at the same location. Once the drying process is completed, the resultant ingredients are available for purchase by feedmillers, who then integrate them into compound feed. Additionally, the rendering of animal-based co-products is another processing activity, elaborated on, on slide 19.



# Ingredient producers and providers - raw material upgrade

The Netherlands is a major player in the European import-export of various agricultural protein sources, such as oilseeds, chicory, pulses, rapeseeds, and sunflower. Many companies used to mainly trade soy but are now looking into other raw materials to reduce dependency on imported soy. Therefore, they are focusing on upgrading raw materials for their protein business model. Some of the big players in this field are Cargill, Louis Dreyfus, Bunge, ADM, CEFETRA and Royal Agrifirm.

In the search for new protein sources, protein levels within the crops are important factors. The alternative agricultural protein sources contain lower levels of protein compared to overseas soy. Also, the yield per hectare is an important factor in this search for alternative protein crops. From the interviews Larive conducted with the Dutch Diamond, the sector is looking into collaborating with seed breeders to improve seeds and optimise protein levels and yield for crops in Europe.

When looking at the crops that offer interesting alternatives as raw materials, the peas are interesting as it has relatively high protein levels, starch and fibre content. Beyond the protein levels, studies have shown that adding peas or pea proteins to piglet feed can improve their growth and health. Field peas can be grown locally and regionally, which reduces transportation costs and emissions. Especially, the production of field peas in eastern central Europe is interesting as the farmland is more accessible and less costly compared to the Netherlands. Considering the relatively close geographic location, there is less transportation emission. Growing these alternative protein crops in Europe is also often subsidised by the European Union. However, the subsidy to grow these crops is sometimes imbalance with the market price based on supply and demand. In combination with the lack of offtake guarantees, this results in cases where the cost of harvesting of the crop is too high in comparison with the market price, leaving the crops go to waste at the farmland.

Another interesting raw material is hemp, as it contains high oil and protein content. It can be used as an alternative protein source for animal feed, especially for fish, poultry, and cattle. Hemp seeds and hemp seed oil meal are rich in protein and oil, essential for animal health and growth. Hemp production is legal and sustainable in the Netherlands, where it has a long history of cultivation and use. Dunagro is one of the leading companies that produces hemp in Groningen, the province where the majority of Dutch hemp is grown.

Bamboo is an innovative raw material that can be used for animal feed. Bamboo is a fast-growing, renewable, and versatile plant that can be cultivated in Spain and Portugal. Bamboo leaves have high nutritional value and can be used as co-products for the feed sector. Bamboologic Europe is a Dutch start-up that grows bamboo in Europe.

Moreover, grass is another rich source of protein that can be converted into animal feed. The Netherlands has abundant grassland where cattle and other livestock feed on the fresh grass. Grassa is an innovative company that turns grass into high-quality products, such as feed, protein, sugar and fertiliser. Grassa uses advanced techniques of pressing, heating, and filtering to extract nutrients from various green sources, such as grass and beet leaves. The company aims to produce protein that is superior and more affordable than soy. This technique can also be used for other (green) sources.

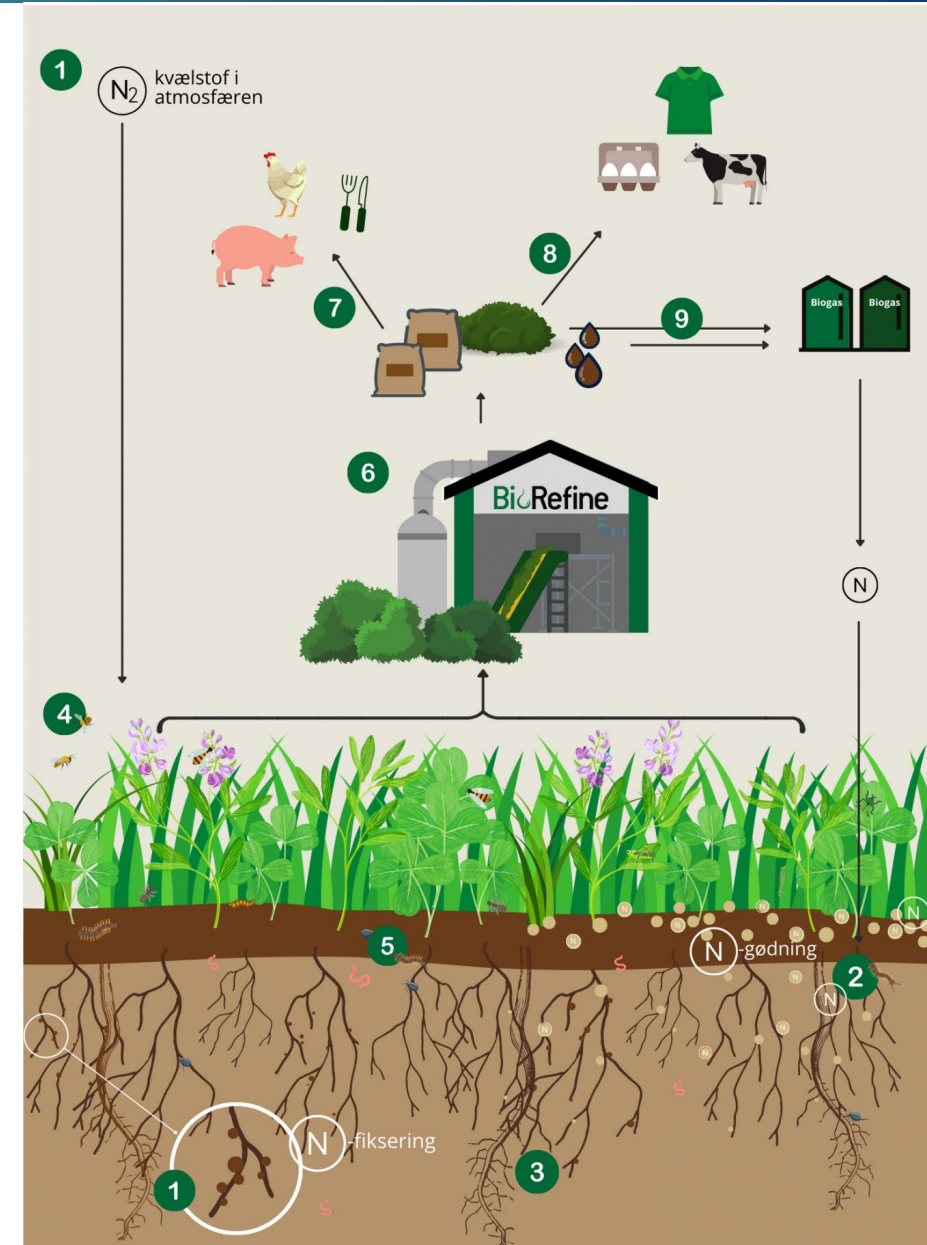


# Ingredient producers and providers - co-products a case study: extracting grass protein in Denmark

BioRefine Denmark A/S is an example of a successful producer of sustainable green protein. The company was founded by three agricultural companies; DLG, Danish Agro, and DLF, with a vision to create a climate- and eco-friendly protein alternative to soy meal for animal feed. The company operates the first biorefinery north of Varde, where it extracts organic green protein from 3,000 hectares (ha) of locally grown clover grass and alfalfa. The company expects to produce about 7,000 MT of organic protein per year, with a crude protein content of over 50%.

The production process starts with the fresh grass, which must be processed within 8 hours after cutting. The grass is shredded and pressed to separate the liquid from the solid part. The solid part, called green fiber, contains about 40% dry matter and can be used for biogas production or other purposes. The liquid part, called green juice, contains the protein that needs to be isolated. The company uses a decanter centrifuge, a device that spins the liquid at high speed and separates the protein from the water based on their density difference. The resulting protein has a high quality and quantity, surpassing other Danish protein crops such as raw peas and faba beans. This achievement not only ensures a more secure protein supply for the Danish animal feed sector, but also contributes to a greener and more sustainable agriculture.

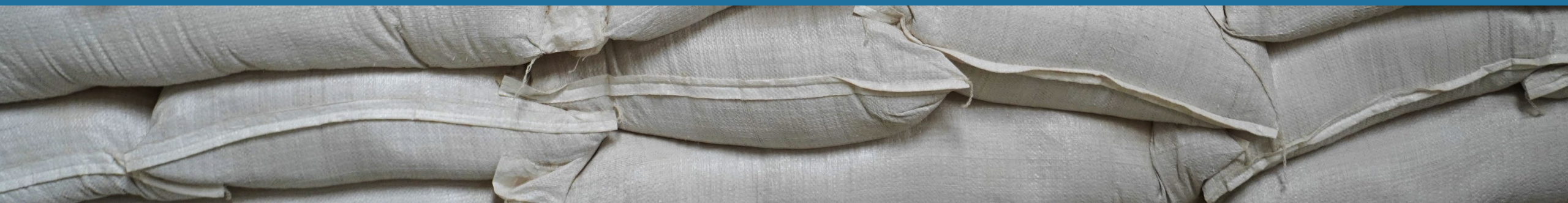
BioRefine is also involved in the "From Green Protein to the Cold Counter" project, which aims to develop new products and markets for green protein. The project has received a grant of DKK 14 Mn (about 1.9 Mn Euros) from the Green Development and Demonstration Programme (GUDP) under the Danish Agricultural Agency.







# Dutch Diamond – Feed producer and distributors





# Feed producers and distributors

This research examines the animal feed producers, the companies responsible for processing feed ingredients into animal feed. The process encompasses multiple stages, such as material handling, drying, grinding, mixing, pelleting, and cooling. Notably, the Netherlands stands as a premier producer of compound feed in the EU, contributing 16.5 MT in 2020, equivalent to 10% of the total EU compound feed production.

Prominently, Dutch feed milling giants such as De Heus, ForFarmers, Agrifirm, Provimi, and Nutreco have a global presence, catering to diverse livestock species. This influence extends to aquaculture, with Nutreco and De Heus being key global players.

The escalating global demand for soy protein, driven by an anticipated 35% increase in global meat consumption, prompts supply constraints and escalating prices. To counteract this trend, major mills proactively seek alternative protein sources that match soy's volume and affordability. These industry leaders also channel investments into novel solutions that bolster their products' long-term sustainability. For example, ForFarmers has a specific ESG strategy for 2025 that aims to source proteins more locally and find more sustainable and circular ingredients. One of their activities is joining the European project of SUSINCHAIN on insect.

In the Netherlands, various feed producers have established business models that markedly reduce reliance on conventional soy protein. They adeptly harness co-products from other industries to produce animal feed. Companies such as Bonda (Agrifirm Group), van Triest, Nijsen, Topfeed, AR co-producten, Voerwaarts Circulair and Denkavit contribute to circular supply chains by processing and grinding co-products according to their nutritional worth.

A noteworthy initiative exemplifying Feed producers' exploration into alternative proteins is an ongoing collaborative pilot project involving major feed millers and co-product processors. This alliance is deeply committed to investigating and advancing proteins derived from fermenting low-value co-products. The focal point of this joint endeavor centres on leveraging co-products with limited commercial viability as protein sources, with the ultimate objective of yielding high-value proteins through this innovative approach.

Despite a declining volume of livestock within the Netherlands, feed producers are strategically shifting their focus towards global markets and foreign investments. Evidently, this transition underscores the growing significance of international avenues with a sustainable focus for these entities. An example of this global activity is a consortium of Skretting (Nutreco), Protix, Veramaris, Klaas Puul and Albert Heijn, where a sustainable shrimp value chain in Ecuador is established using insect protein and algae omega 3 oil.





# Case study: creation of new market segments

## Cultivated meat, creating new market segments

Developments within the food sector for alternative proteins, such as cultivated meat, are causing transformative shifts and creating new market segments for the animal feed sector. A case study exemplifying this is the collaborative initiative named "Feed for Meat", undertaken by Nutreco, a global leader in animal nutrition and Mosa Meat, a Dutch innovator in cultivated beef production.

The collaboration seeks to lower costs for beef cultivation. By substituting expensive pharmaceutical-grade ingredients with more economical feed- and food-grade products, they aim to lower the costs by 100 times. Beyond cost reduction, the initiative prioritises sustainability by harnessing food and feed industry co-products with low environmental impact. Fuelling the momentum of "Feed for Meat" is a substantial grant of nearly EUR 2 million from the European REACT-EU recovery assistance programme. This grant, secured in a highly competitive arena with over 60 funding applications, underscores the project's prominence and innovative vision.







# Dutch Diamond – Feed safety





# Feed safety

Food and feed safety entails preventing any unacceptable risks, including microbiological, chemical or physical hazards, to both humans and animals. Establishing food and feed safety forms the basis of legislation and regulation, guiding the Netherlands Food and Consumer Product Safety Authority (NVWA) in organising and executing its supervisory responsibilities in the Netherlands. The NVWA aligns with the newly implemented European Control Regulation to strengthen the system by broadening registration requirements and authorisations for entities under NVWA's supervision.

In the context of animal feed, this encompasses all substances and products, including ingredients and additives, that are processed, partially processed or unprocessed and intended for oral consumption by animals. However, animal feeds can only be introduced into the market if they meet certain criteria: they must guarantee safety, not harm the environment or animal welfare, and demonstrate suitability, purity, healthiness, and suitable for their intended purpose.

To produce and sell animal feed, companies must be registered with the NVWA, allowing regular safety checks. Notably, over 95% of animal feed companies in the Netherlands are affiliated with the private quality system known as GMP+-international. GMP+ stands for Good Manufacturing Practices Plus, where the "Plus" signifies the incorporation of Hazard Analysis and Critical Control Points (HACCP) principles within the certification process. This requirement ensures that animal feed products originate from GMP+-certified companies.

In terms of organisations engaged in feed safety, they can be classified into public entities responsible for policies and regulations, and private feed safety providers offering services to ensure safety throughout the supply chain.

**Public feed safety providers** include the NVWA and BuRO, the latter being an independent division of the NVWA. Both organisations focus on food safety, product safety, plant and animal health, animal welfare and the natural environment (incl. biodiversity). While the NVWA monitors animal and plant health, animal welfare, and food and feed safety while enforcing nature-related laws, BuRO offers scientific counsel on risks associated with these domains. Additionally, the RIVM operates as an organisation focusing on public health and the environment. It provides counsel to the national government, other authorities, professionals and citizens concerning diseases, health and preventive measures.

**Private feed safety providers** such as Eurofins, NutriControl, and Normec Foodcare are privately-owned companies providing services related to food and feed safety and quality control. They offer a range of services, including analytical testing, laboratory research, QA automation, education and training, risk management, and label control. These private feed safety providers work alongside public feed safety providers such as NVWA, BuRO and RIVM to comply with safety policies and regulations in the feed sector in the Netherlands within the Netherlands.

For feed protein analysis, the feed safety providers examine not only the protein value but also the protein profiles. The protein profile reflects the composition of amino acids in a protein. This profile is important for the protein intake, digestion and growth rate. Consequently, the protein profile has an influence on the quality and ultimately of safety of meat consumption. To test this process, the Phyto and In Vivo tests are used to simulate animal nutrition.

Moreover, the pure feed safety tests performed, include the Mycotoxin test, which detects and measures toxic compounds from molds or fungi in feed. If errors are found, the feed safety players are obliged to contact the NVWA.



## Feed safety (cont.)

One example of a collaboration between a private feed safety provider and a feed company is the collaboration between NutriControl and Bonda. NutriControl is a Dutch company that provides analytical services for food and feed safety, quality, and authenticity. Bonda is a Dutch company that produces liquid feed for ruminants, such as cattle, sheep, and goats. The collaboration between NutriControl and Bonda involves the use of near-infrared (NIR) spectroscopy, which is a technique that measures the absorption of infrared light by molecules in a sample. NIR spectroscopy provides information on the composition and quality of feed and ingredients, such as moisture, protein, fat, fibre, ash, starch, sugar, and minerals.

Bonda has NIR scanners at its production facilities to perform analysis on samples. The data from the NIR scanners are sent to NutriControl. NutriControl analyses the data using its calibration models, based on extensive database. NutriControl then provides Bonda with accurate and reliable results on the composition and quality of its feed and ingredients within minutes. This way, Bonda can monitor and optimise its production process in real time and ensure that its feed meets the requirements and regulations.

A similar process is executed at Nutreco, a Dutch company that produces animal nutrition and aquafeed products. Nutreco has its own in-house laboratory called MasterLab, which analyses samples from its global operations using NIR scanners. MasterLab also collaborates with NutriControl to validate its calibration models and ensure the accuracy and consistency of its NIR results.

Regarding new innovations in feed safety, the Wageningen Food Safety Research specialises in forensic measurements, conducting advanced research, and developing methodologies to identify substances within feed.

### Feed safety involving animal-based co-products

Animal by-products represent a significant subject in feed safety due to the potential risk of carrying Transmissible Spongiform Encephalopathies (TSEs). TSEs involve a group of severe and fatal diseases affecting brain and nervous system of diverse animals, such as cattle and sheep and also humans. These diseases are linked to prions, abnormal proteins causing misfolding or aggregation of regular proteins within the body.

In order to use animal by-products in feed, a process known as rendering is performed. This process transforms waste animal tissue into stable, usable materials. The NVWA has categorised rendering products into three distinct categories:

**Category 1:** This category presents the highest risk and includes materials like carcasses of animals suspected of carrying TSEs.

**Category 2:** This classification comprises animal by-products such as manure and materials containing residues of permitted substances or contaminants exceeding the allowed levels.

**Category 3:** This category comprises animal by-products, such as carcasses and parts of animals, suitable for human consumption but unsuitable for commercial considerations. This category also includes animals that show no symptoms of diseases transmissible to humans or animals.

It is important to note, category 1 and 2 materials are strictly prohibited for usage in animal feed. Only category 3 material is allowed for use as an ingredient in fish feed. Nonetheless, category 3 material is currently not permitted for poultry, pig feed and feed for ruminants. Additionally, animal by-products can be used in pet food. To render animal by-products to be suitable for the feed market (fish feed and pet food), they must undergo pressure sterilisation. This process involves reducing the particle size to no more than 50 mm and subjecting the material to a core temperature of over 133 °C for at least 20 minutes without interruption. This operation must transpire at an absolute pressure of not less than 3 bar. For instance, Noblesse proteins, a consortium of Dutch poultry slaughterhouses, transforms 80% of all poultry slaughterhouses by-products in the Netherlands into category 3 animal by-product proteins and fats, culminating processing of 5000 MT of raw material into 1000 MT of end products.





# Innovation hubs





# Innovation hubs - public

This chapter elaborates on the different innovation hubs involved in the feed sector in the Netherlands. At innovation hubs, diverse (public and private) stakeholders collaborate to generate, test and implement concepts. These hubs play a vital role in enhancing animal feed innovation, production, quality, and sustainability. Feed development is important for ensuring animal health and welfare, reducing environmental impact, enhancing food quality and safety and increasing productivity and profitability. These innovation hubs engage players along the entire value chain collectively advancing the protein transition.

## Public innovation hubs

Public innovation hubs are mainly supported and controlled by public-sector actors, such as governments, public agencies, universities, or research institutes. They usually operate under public-interest principles and aim to advance scientific knowledge, public welfare, or national competitiveness. They may focus on basic research or emerging technologies that have high potential value or strategic importance. Some examples of public innovation hubs are Wageningen University, Wageningen Nutrition Innovation Lab, Food Innovation Hub Europe, Brightlands Campus Greenport Venlo.

- Wageningen University is a prominent catalyst for innovation within the Netherlands, driving the protein transition through groundbreaking ideas and solutions.
- Wageningen Animal Nutrition Innovation Hub: This is a platform that connects researchers, companies, farmers and policy makers to exchange knowledge and ideas on animal nutrition. It is hosted by Wageningen University & Research, a leading institution in animal science and innovation. The hub organizes events, workshops, webinars and projects that cover topics such as feed efficiency, gut health, alternative protein sources, feed additives, precision feeding and animal welfare.
- Brightlands Campus Greenport Venlo: This dynamic open innovation community in Limburg prioritises future farming, nutritious diets and circular bio-economy, bolstering innovation in the sector.
- StartLife is an accelerator for agri-food tech startups. It supports entrepreneurs who have innovative ideas and solutions for the food and agriculture sector and offers various services and benefits to its startups, such as mentoring, training, funding, networking, and access to a world-renowned agri-food tech ecosystem. StartLife is a non-profit organisation that is funded by various public and private partners, such as Wageningen University & Research, Foodvalley NL, Rabobank, Unilever, and the Dutch government. It operates as an independent and neutral platform that supports agri-food tech startups. StartLife does not take any equity or ownership stake in the startups that it accelerates, but provides them with grants, loans, and access to its network of investors. Some examples of feed-related startups that have participated in StartLife's programmes are Protix and InsectSense.





# Innovation hubs - private

## Private innovation hubs

Private innovation hubs are mainly financed and owned by private-sector actors, such as corporations, venture capitalists, foundations, or individuals. They typically operate under market-based principles and aim to generate profits or social returns for their investors and stakeholders. They may focus on specific sectors or technologies that have high commercial potential or social impact. Examples of private innovation hubs are Laverdonk, Feed Design Lab, Insect Experience, and Eiwitcampus Beers.

- **Research farm Laverdonk:** This is Agrifirm's research farm specialising in insect-based feed ingredients for aquaculture and poultry. It produces high-quality protein from black soldier fly larvae, which can reduce the environmental impact and cost of animal feed. Laverdonk also collaborates with other stakeholders to promote circular economy and insect farming.
- **Feed Design Lab:** This is a research and education centre that fosters innovation and sustainability within the feed industry. It offers a unique pilot plant where new feed ingredients, production processes, and technologies can be tested and demonstrated. It also organizes workshops, courses, and events to share knowledge and stimulate cooperation among feed companies, suppliers, research institutes, and educational institutions.
- **Insect Experience:** This is a platform that advocates for insect usage in food and feed applications. It organises events, workshops, and campaigns to raise awareness and acceptance of insects as a nutritious and sustainable food source. It also connects insect producers, processors, retailers, chefs, consumers, and researchers to create a vibrant insect community.
- **Eiwitcampus Beers:** This is a noteworthy private hub that nurtures practical start-ups in the field of protein transition. It offers both a conducive environment and sector-specific networking opportunities for entrepreneurs who want to develop innovative products or services based on plant-based or alternative proteins.
- **Feed Innovation Services:** This is a consultancy firm that provides services and solutions for feed innovation, such as product development, process optimisation, quality control, market research and business strategy. It has a network of experts and partners from the feed industry, academia and government. It organises the Feed Design Contest, an annual competition that challenges students and young professionals to design innovative feed products.

Collectively, these innovation hubs fuel progress, positioning the Netherlands at the forefront of transformative developments in the animal feed landscape.







# Dutch Diamond – sector organisations



# Sector organisations

The feed sector in the Netherlands is represented by several sector organizations that advocate for their members' interests and promote sustainable practices. They also provide various services and benefits to their members, such as information, resources, collaboration, and innovation. Some of the prominent sector organizations in the feed industry are Nevedi, VIDO, NGN, Foodvalley, MVO ketenorganisatie, and The Protein Community

- De Nederlandse Vereniging Diervoederindustrie or the Dutch Feed Industry Association (Nevedi), covers about 95% of all animal feed production in the country. It represents companies that produce compound feed, milk replacers, premix additives, and wet feed.
- Voedingsmiddelen In Diervoeder Overleg (VIDO): The trade organisation for companies that produce high-quality animal feed from by-products of the food industry. Its members include FeedVallid, Nijsen, Agrifirm, TopFeeds, and Smits.
- MVO: The chain organisation for oils and fats, which represents companies that are involved in the production, processing, and trade of vegetable and animal oils and fats.
- NGN is a social enterprise that develops the insect sector in the Netherlands and in African countries. It works on several international projects, such as the European SUSINCHAIN project.
- Foodvalley NL and the Protein Community: An independent organisation that drives collective action with frontrunners across sectors and countries to shape the future of food. It hosts the Protein Community, which connects alt-protein start-ups and corporates worldwide and accelerates their innovations and business growth.

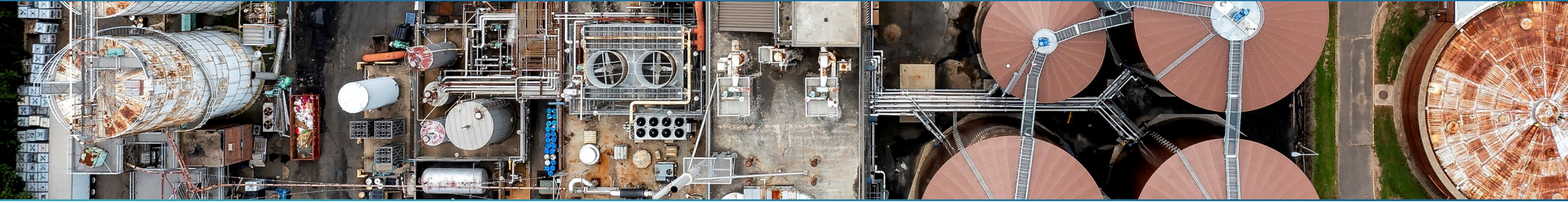
These sector organisations can support the development of alternative proteins by providing information and resources to their members, facilitating collaboration between companies, and engaging in advocacy work to promote supportive policies and regulations. By working together, companies in the feed sector can help drive innovation and accelerate the adoption of alternative proteins, contributing to a more sustainable future for the industry.







# SWOT analysis





# SWOT analysis Dutch ecosystem

Internal origin

## Strengths

- **Complete value chain presence, with multinational players with global impact:** The feed sector covers the entire value chain from agricultural production to feed production, and includes multinational companies with substantial R&D, manufacturing and decision-making activities such as Nutreco, DSM, and Cargill.
- **Global scientific leadership: leading research on alternative protein:** The Netherlands is a pioneer in developing and implementing alternative protein sources, such as insects, algae, and single-cell proteins, to reduce the environmental impact and increase the sustainability of animal feed.
- **Advanced protein production innovation over the entire value chain:** The feed sector invests heavily in research and development of new technologies and processes to improve the efficiency and quality of protein production, such as biorefinery and fermentation.
- **Expertise in providing technology for- and efficiently processing co-products and animal-based co-products:** The feed sector has a long history of using co-products as a valuable source of protein and nutrients for animal feed and has developed advanced technologies to ensure their safety and quality.
- **Innovative ingredient production and constant search for new sources:** The feed sector is constantly looking for new and novel sources of ingredients for animal feed, such as seaweed, microalgae, fungi, bacteria, and plant-based proteins.
- **Synergy of food processing and livestock sectors that allows the co-product valorisation of alternative proteins.** The geographical proximity of these sectors reduces the transport costs and environmental impacts of animal feed production and distribution. The Dutch feed sector can leverage the existing collaboration and integration of the food processing and livestock sectors to create more sustainable and circular food systems.
- **Strong intersectoral collaboration and investments:** the Dutch feed sector works closely with other sectors, such as agriculture, biotechnology, energy, and environment, to create synergies and foster innovation in the field of animal feed. For example, Protix – ForFarmers, Nutreco – Mosa Meat and Veramaris – DSM.
- **Critical Dutch market pushing the protein transition:** The Netherlands has a critical home market and the Dutch government is leading the way in promoting and supporting the transition to more sustainable and circular food systems. The country has a strong focus on this theme, as it faces the urgency of reducing its environmental impact and improving its food security. The Dutch stakeholders are actively pushing for the transition to alternative proteins and are willing to collaborate and innovate with different actors in the sector.
- **Government willingness to enable new protein sources:** Insect production in policies since 2009: The Dutch government has been supportive of the development and implementation of new protein sources for animal feed, especially insect production, which has been included in its policies since 2009.
- **World leading scientific research environment:** The Dutch feed sector has access to a world-class scientific research environment, which includes renowned universities, research institutes, and innovation centres that conduct cutting-edge research on animal feed.

# SWOT analysis Dutch ecosystem

Internal origin

## Weaknesses

- **Large dependency on conventional soy due to volume requirements:** The sector relies heavily on imported soy as major source of protein for animal feed, which poses risks such as price volatility, environmental impact, and social issues.
- **Cost-driven feed market involving large scale and small margins for feed ingredients:** The feed sector faces a highly competitive and price-sensitive market, which limits the profitability and innovation of potential protein sources.
- **Scaling requires capital-intensive investment:** The sector needs significant investment in new technologies and infrastructure to be able to scale up production of alternative protein sources. Making it for startups difficult to scale.
- **High-value input requirement (GMP+) for insect production, raising production costs:** The feed sector has to comply with strict quality and safety standards (GMP+) for insect production, which increases the production costs and reduces the availability of suitable feedstocks for insect rearing.
- **Bioenergy subsidies diverting co-products from the animal feed industry:** The feed sector competes with the bioenergy sector for the use of co-products from the food processing and livestock sectors, which are subsidised by the government to promote renewable energy production.
- **Volume challenges for initiatives, failing to replace conventional protein volumes for off-take insurance:** The feed sector faces difficulties in ensuring a consistent and sufficient supply of alternative protein sources, which are often produced in small batches and vary in quality and composition.
- **Highly competitive market leading to little collaboration and knowledge sharing:** Reducing learning and innovation opportunities in the animal feed sector.
- **Due to lack of scale, initiatives are either completely manually (high human resource investment) or too high-tech (high capital investment), leading to high production costs:** The feed sector has to deal with the trade-off between labour-intensive and capital-intensive production methods for alternative protein sources, which both result in high production costs and low efficiency.
- **High price of co-products due to efficient value chain:** The feed sector pays a high price for co-products from food processing and livestock sectors, which are efficiently used and valorised by these sectors, which reduces the economic attractiveness of these co-products as animal feed ingredients.
- **Locally present protein crops unable to compete with soy yield and protein values:** The feed sector has a limited potential to use locally grown protein crops (e.g., lupin, pea and rapeseed), as ingredients, as they have lower yield and protein content than soy. Investing in large-scale production of alternative protein sources is very capital-intensive.
- **Pace of the protein transition partially depends on the allocation of financial resources for R&D and scaling publicly and privately.** R&D in alternative protein is capital intensive due to the innovation aspect.



# SWOT analysis Dutch ecosystem

External origin

## Opportunities

- **National strategic importance:** supporting the Dutch Diamond in its transition to alternative proteins suits within national policies to reduce emissions.
- **Possibility to seize opportunity of increase in meat consumption in emerging markets:** to promote and export its alternative proteins as a more sustainable and circular option for animal feed. These markets have a high demand for meat products, but also face the greatest environmental effects of conventional animal production, such as greenhouse gas emissions, land use, water use, and biodiversity loss. The Dutch Diamond is strong and innovative and can leverage its expertise and experience in alternative protein production and valorisation to create more value-added products and services that meet needs and preferences of emerging markets. The Netherlands can also benefit from the innovation and collaboration opportunities arising from engaging in the global market.
- **Upcoming EU regulation on deforestation free products in 2025:** will create a higher demand for alternative protein sources that are more sustainable and traceable than soy.
- **Collaboration with seed breeding sector to optimise and increase protein levels in crops suitable for European climate:** Potential collaboration with the seed breeding sector to develop and grow new varieties of protein crops, such as lupin, pea, and rapeseed, that are adapted to the European climate and have higher yield and protein content than soy.
- **Combining various alternative proteins for replacing soy for animal feed:** The sector can explore the possibility of using a combination of different alternative protein sources, such as insects, algae, single-cell proteins, and plant-based proteins, to replace soy.
- **Large availability of potential extraction protein from currently unutilised grass:** The feed sector can utilise the large amount of grass that is currently not used for animal feed and extract protein from it using biorefinery technologies.
- **Innovative micro algae production with potential to scale:** The feed sector can invest in innovative micro algae production methods, such as photobioreactors, open ponds, and wastewater treatment systems, that have the potential to scale up and produce large quantities of high-quality protein for animal feed .
- **Exploring lower-value waste streams for insects, backed by research and proof of concept:** Using lower-value waste streams, such as organic waste as inputs for insect cultivation, can reduce the production costs.
- **Collaboration in offtake guarantees for alternative proteins growers create willingness:** This can create a willingness and incentive for the feed sector to invest in and scale up the production of alternative protein sources .
- **Algae application supported by proof of concept:** Possibility to apply algae as a source of protein. It is supported by proof of concept that show the nutritional value, quality and safety advantages. Algae can also provide other benefits, such as omega-3 fatty acids, antioxidants, and pigments .
- **Small-scale processing units at food processing companies offer co-product utilisation possibilities:** This can reduce the transportation costs and environmental impact of co-product utilisation and increase efficiency and quality of co-product valorisation .
- **Large companies able to reach large scale and impact:** The Dutch feed sector has large multinational companies that have the capacity and resources to reach large scale and impact. These companies can leverage their global network, market access, research and development capabilities, and innovation potential to drive the protein transition.
- **Increasing demand for soy in China, leading to less availability for Europe:** China is expected to increase its consumption of soybeans, which will reduce the supply and increase the price of soybeans for the European market.

# SWOT analysis Dutch ecosystem

External origin

## Threats

- **Upcoming trend of using co-product streams towards the energy sector, due to subsidies in bio energy.** The Dutch feed sector faces the threat of losing co-product streams from food processing and livestock sectors, which are valuable sources of protein and nutrients for animal feed, to the energy sector. The energy sector is subsidized by the government to use co-products for bioenergy production, which makes them more attractive and competitive than animal feed .
- **Dilemma of Feed safety regulations with GMP+ material for insects' production, leading to a high-cost price.** The sector has to comply with strict feed safety regulations, such as GMP+ which requires the use of high-value input materials, such as grains and oilseeds, for insect rearing. This leads to a high-cost price and low profitability, reducing its competitiveness and attractiveness.
- **Reduced livestock volume leading to less market for off-setting co-products.** The reduction of livestock volume, especially pig livestock, will reduce the demand and consumption of animal feed, especially pig feed, which is best suited for using co-products from food processing and livestock sectors. These co-products are valuable sources of protein and nutrients for animal feed, but they may lose their market and profitability if the livestock volume decreases.
- **Energy crisis reducing potential growth of insects as a protein source.** Currently used insect breeds are tropical and subtropical, characterising energy-intensive production: The insects require high temperatures and humidity levels to grow and reproduce, which leads to energy-intensive production methods
- **Conflict of interest between government and agricultural sector.** The ongoing debate on the future of the agricultural sector in the Netherlands with respect to economic and environmental challenges.
- **Large volume of low-cost imported algae from Asia, not guaranteeing nutritional values.** The sector faces the threat of being outcompeted by low-cost imported algae from Asia, which are produced in large volumes and sold at lower prices than domestically produced algae. These imported algae may not guarantee the nutritional values and quality standards.
- **The envisioned reduction of meat production in the Netherlands and Western Europe** could have a negative impact on the alternative protein ecosystem. The current ecosystem relies on the presence and investment of conventional animal feed producers, who are also innovating in alternative proteins. If these players decide to leave or reduce their activities in the Netherlands, the ecosystem could lose its competitive edge and innovation potential.
- **Public funding versus research.** The scaling of alternative proteins is still in the development phase and requires significant investment to scale up and commercialise. The Netherlands has a leading role in the research and innovation of alternative proteins, with WUR as a key partner. If public funding is perceived as unsatisfactory, development and innovation is slowed down or halted. The market needs public funding to support scientific and technological advancement and to facilitate collaboration and knowledge transfer among different stakeholders in the sector.





# Recommendations



# Recommendations

## 1. Research and proof of concept for lower-costs inputs for insects' rearing

The insect industry is a promising sector that can provide high-quality protein for animal feed while reducing the environmental impact compared to conventional protein sources. However, the sector faces challenges, especially in terms of the feedstocks used for insect rearing.

According to the interviews conducted by Larive with various stakeholders in the insect industry, the current regulations that require insect producers to comply with GMP+ standards, limit the scalability and profitability of the sector. GMP+ standards are strict quality and safety criteria that apply to animal feed production. They allow insect producers to only use high-value inputs, such as grains or oilseeds, also suitable for direct processing in animal feed. This increases production costs and reduces the availability of feedstocks for insect rearing. Moreover, it creates an inefficient supply chain, as the insects could potentially replace some of the inputs in the feed industry.

A potential solution to this problem is to allow usage of lower-value inputs, such as manure and sludge, that cannot be directly used in the feed industry. These inputs are abundant, cheap and offer a sustainable way to valorise waste streams from the agriculture and food sector. By using lower-value inputs, insect producers could lower their production cost and make their products more competitive and attractive for Feed producers. This would lead to an increase in the volume and market share of insect protein in the feed industry.

However, before this can happen, research and development is needed to ensure lower-value inputs are safe and suitable for insect rearing. Therefore, it is recommended that the government invests in research on lower-value waste streams for insects and develops a proof of concept. Once the proof of concept is established, the NVWA could adjust its GMP+ compliance regulations for insect production accordingly. This would enable the insect industry to grow and contribute to a more circular and sustainable food system.

## 2. Support and collaboration with large-scale companies in the feed industry

As meat production in Western Europe and the Netherlands is decreasing, so is the business for the large feed ecosystem players in the region. The current ecosystem depends on the presence and investment of conventional animal feed producers, who are also innovating in alternative proteins.

However, if these players decide to leave or reduce their activities in the Netherlands, the Dutch Diamond might lose its competitive position and innovation potential. Therefore, it is important for the government to collaborate closely with the feed sector and provide them with a long-term overview of policies and regulations. With national demand for feed decreasing in the coming years, the large multinational feed companies are adjusting their business to remain viable for the long term. Adjustments in large organisations require time and, therefore, the feed companies cannot respond to certain changes in regulation in a flexible way. Hence, it is advised that the Dutch government supports the market leaders in their long-term strategy and transition efforts by being transparent and maintaining a stable political direction.



# Recommendations

## 3. Long term fundings focus

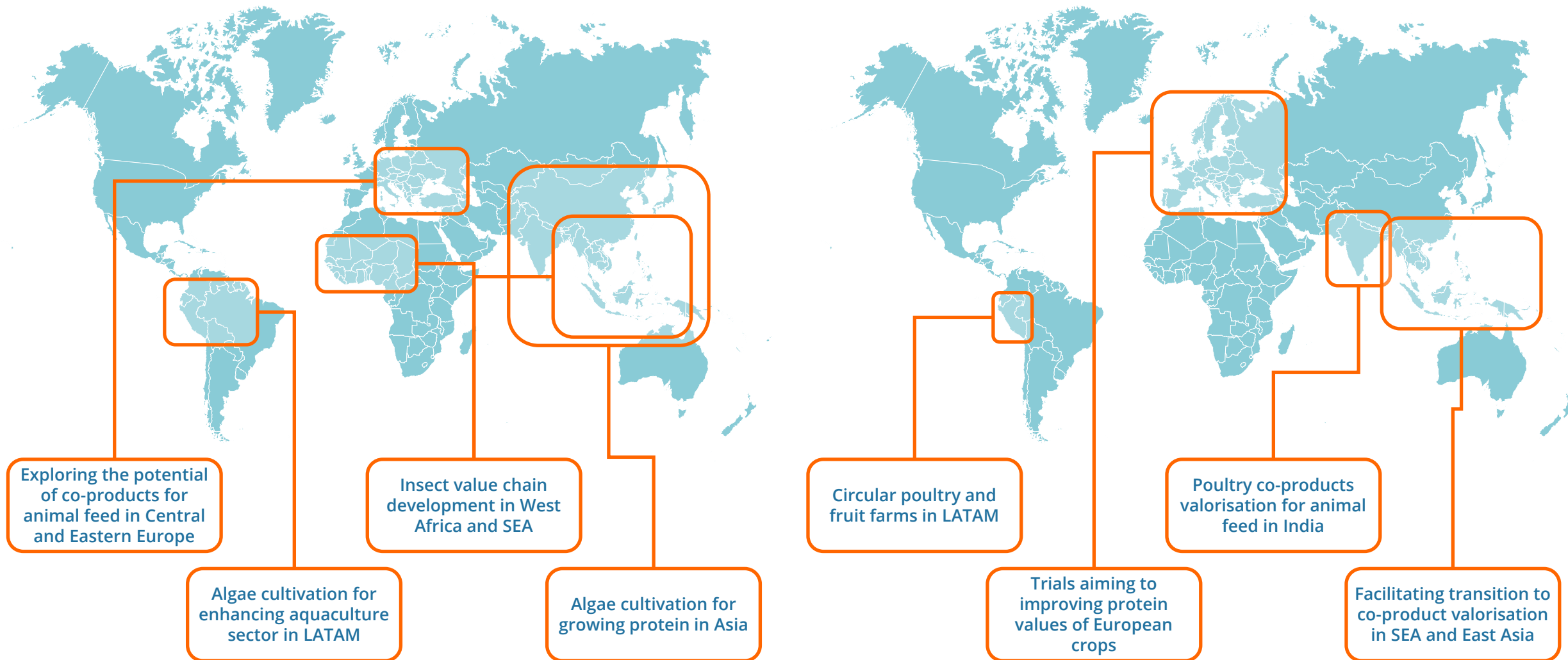
To establish an alternative protein solution of scale, a long-term vision and long-term commitment of budget are required. For example, Veramaris, could be considered a success story of a solution that reached a certain scale. One of the success factors is the large investment of DSM and EVONIK, who jointly invested approximately 150 to 200 million EUR in the project. Many promising initiatives in this sector still need funding to innovate and scale their business. However, the funding climate may change and cause these initiatives to relocate or discontinue. This would result in a lack of innovative ingredient development and a constant search for new sources in the Dutch Ecosystem. Therefore, it is advised that the government should provide funding security for promising alternative protein solutions for continuous innovations. This would support their long-term vision and innovation potential.

## 4. Invest in single cell protein

Single-cell protein extraction is a promising technology that can produce high-quality protein from non-food waste streams using e.g., fermentation. However, this technology is still in its developmental stages and requires significant initial investments to achieve scalability and cost-effectiveness. The Netherlands has a strong potential to become a leader in this field, as it has already developed an innovative protein fermentation concept. Investing in this concept would benefit the Dutch Diamond and its international position, as well as contribute to the global transition to more sustainable and circular protein sources. Therefore, Larive recommends the government supports the R&D and scaling of this technology.



# Recommendations for Dutch alternative protein sector opportunities abroad





# Recommendations for Dutch alternative protein sector opportunities abroad

## How to support and promote the Dutch Diamond players internationally?

The Dutch Diamond is one of the frontrunners in the field of alternative proteins, such as insects, algae and plant-based products. These proteins can contribute to a sustainable, healthy and food-secure future. The Dutch sector has a lot of knowledge, expertise and innovation potential, which can be recognised and utilised internationally. To support and promote the sector, nationally and internationally in the development and further strengthening of its position in the alternative protein landscape, Larive recommends and sees opportunities with the following geographical and sectoral focus.

### 1. Exploring the potential of co-products for animal feed in Central and Eastern Europe

Central and Eastern Europe are attractive markets for co-product ingredient producers and processors sourcing co-products. The region has a large food processing industry and a high availability of bio-ethanol waste streams, which are protein-rich co-product sources. Moreover, there is a large demand for feed. Additionally, this region is geographically close to the Dutch market.

Given these favourable conditions, there is an opportunity to establish a co-product valorisation value chain. Larive recommends to conduct a feasibility study to explore this potential. The main objective is to map the waste streams from the food processing and bio-ethanol industry, and to identify the potential off-takers for valorised co-products. It will provide valuable insights for various stakeholders such as ingredient distributors, feed millers, and farmers. Based upon the results, Larive recommends to execute a pilot project covering the valorisation of the value chain to test and validate the economic and technical viability.

### 2. Insect value chain development in West Africa and/or Southeast Asia

The (sub)tropical climates of West Africa and Southeast Asia offer (more) favourable conditions for insect growth and production. These regions also provide waste streams from the food processing industry, serving as low-cost and sustainable inputs for insect cultivation. Insect-based protein provide a valuable source of nutrition, as well as contribute to environmental conservation and food security.

To explore the potential of developing an insect value chain in these regions, Larive recommends assessing the feasibility. The study could include a comprehensive mapping of the available waste streams, their suitability for different insect species, identifying possible off-takers, the potential markets and its customers for insect-based protein ingredients. Based on the findings of the study, Larive recommends to set up a pilot project to test and validate the technical and economic viability of the insect value chain.



# Recommendations for Dutch alternative protein sector opportunities abroad (cont.)

## 3. Algae cultivation for growing protein in Asia

Algae cultivation is a promising way to produce animal feed from sugar waste streams, which are abundant in some Southeast Asian and East Asian countries. These countries, such as Vietnam, Thailand, Indonesia and India, have a large sugar industry that generates waste products that can be used as inputs for algae growth. They also have a growing demand for animal feed, especially for poultry and aquaculture sectors, as their protein consumption is increasing. Algae cultivation can help these sectors develop sustainably by providing a high-quality and low-cost feed alternative.

Larive proposes to conduct a feasibility study of algae cultivation using waste streams (e.g., sugar) in these countries. The study should include a detailed analysis of the availability and quality of sugar waste streams in different production areas, the optimal conditions and methods for algae production, and the market opportunities and challenges for algae-based feed products. Based on the results, a pilot project can be designed and implemented to demonstrate the technical and economic performance of the algae cultivation system.

## 4. Algae cultivation for enhancing aquaculture sector in South America

Algae cultivation could improve the environmental and economic sustainability of aquaculture sector in South America. The region has a rich diversity of freshwater and marine algae species that can be used as feed, biofertiliser, bioremediatory or value-added products for aquaculture. Some of these species, such as Spirulina, Chlorella, and Macrocyctis, have high nutritional value and can enhance the growth and health of fish and shrimp. Algae help to reduce the dependence on fishmeal and fish oil, scarce and expensive resources. Moreover, algae cultivation can provide ecosystem services, such as carbon sequestration, nutrient recycling, and water purification, that can mitigate the environmental impacts of aquaculture.

Larive suggests to conduct a market assessment of algae cultivation for aquaculture sector in South America. The assessment should include a review of the current status and trends of algae production and utilisation, identification of most suitable algae species and cultivation systems and evaluation of the economic feasibility and social acceptability of algae-based solutions. Based on the findings, a business plan can be developed for a consortium and a consortium can be set up to promote adoption and scaling of algae cultivation for aquaculture sector in South America.





# Recommendations for Dutch alternative protein sector opportunities abroad (cont.)

## 5. Facilitating transition to co-product valorisation in Southeast and East Asia

The food processing industry in Southeast and East Asia, especially in Korea, Thailand and Vietnam, is highly developed and produces a lot of co-products from its operations. These co-products can be used as feed for the aquaculture and livestock sectors, which are also large and growing in these countries. However, there is room for improvement in the efficiency and sustainability of co-product utilisation. The Dutch sector has a lot of experience and expertise in this field and can offer solutions and cooperation to the Asian partners. This would not only benefit the environment and the food security of these countries, but also strengthen the position of the Dutch Diamond in these markets.

## 6. Trials aiming to improving protein values of European crops

Optimising protein levels for alternative plant-based crops in collaboration with seed breeding companies.

Alternative plant-based crops, such as faba beans and peas, are potential sources of protein for animal feed and human food. However, these crops have lower yields and protein levels than soy. Central and Eastern Europe produce a significant amount of these crops, but they need to improve their quality and efficiency to compete with soy. Therefore, conducting trials can enhance the nutritional and protein values of these crops. Trials will involve a cluster of stakeholders from the value chain, including seed breeding companies, knowledge institutes, ingredient distributors, feed millers and farmers. Trials will focus on innovative enhancements in seed quality and agricultural practices.

In terms of protein content, raw materials such as faba beans and peas exhibit relatively lower yields and protein levels compared to overseas soy. Central and eastern Europe notably contribute a substantial volume of these crops. Consequently, there is a proposition for conducting trials aimed at enhancing the nutritional and protein attributes of these raw materials within the region. A collaborative approach is suggested, involving seed breeding companies, knowledge institutes, ingredient distributors, feed millers, and farmers in a cluster. These endeavors could focus on innovative enhancements in seed quality and agricultural practices. Furthermore, these trials hold significance for potential flavor modifications in the food sector, ensuring desirable taste profiles for alternative protein products.



# Recommendations for Dutch alternative protein sector opportunities abroad (cont.)

## 7. Poultry co-products valorisation for animal feed in India

India's poultry sector generates a large volume of co-products, such as feathers, blood, and bones, which are often wasted or disposed. This causes environmental and health problems, as well as a loss of valuable resources. A possible solution is to render these co-products into animal feed ingredients, creating value and income generation.

India has a vision of sustainable waste management and optimal resource utilisation and has recently introduced new regulations that support rendering poultry waste into feed. This creates opportunities for the rendering sector, which can benefit from the growing demand for poultry and other animal feed in the country. To understand the benefits and challenges of this approach, a market research in this sector is recommended.

## 8. Circulair poultry and fruit farms in Peru

Peru is major exporter of fruit in the world, with grapes, blueberries, avocados, mangoes, and citrus as its main products. The Netherlands imports about 13% of its fresh fruit from Peru. Peru also has a large poultry sector, which accounts for 78% of the country's livestock farming. Currently, these two sectors complement each other, as poultry manure is used as fertiliser for the fruit trees and waste from one system becomes the input for another, creating a closed loop of nutrients and energy.

Additionally, to make this existing collaboration more circular, a technology of a Dutch company called Grassa can produce green leaf protein from the pruned leaves of the fruit trees. The green leaf protein could (partially) feed the poultry, while the manure enriches the soil and helps the trees grow.

This circular model benefits both the poultry and fruit farmers. The poultry farmers can reduce their feed input, while fruit farmers can increase soil quality and crop yield.

Larive advises to explore this recommendation by conducting a feasibility study for a pilot project. A feasibility study would evaluate the technical, financial, and operational aspects of implementing the pilot project's circular model, as well as the risks and opportunities involved.







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