



BeanMeals

Thinking beyond the can

Putting beans on the plate

Analysis of UK demand and supply of beans and plant-based proteins

Research and report by
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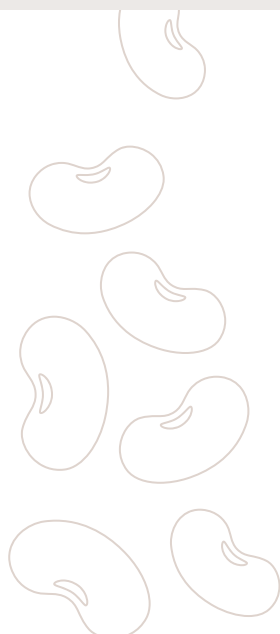
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Executive summary

Why beans matter

The challenges that we face in our food systems are complex.

- Between 702 and 828 million people were affected by hunger globally in 2021,¹ while two billion people are living with obesity or are considered overweight² and one in five deaths are associated with poor diet.³
- The food system contributes 37% of greenhouse gas emissions globally, with agriculture representing 23%.⁴
- Agriculture is responsible for 80% of global deforestation⁵ and 70% of freshwater withdrawals.⁶
- One third of all food produced is either lost or wasted.⁷

We need a transition in the way we manage land and marine environments, how we produce food and, crucially, what we eat.^{8,9} In high income countries, this dietary shift will require much lower consumption of meat and dairy foods, higher consumption of vegetables and whole grains, and minimal consumption of processed foods that are high in fat, sugar or salt.¹⁰ Legumes such as beans, being high in protein and having lower environmental impacts than meat as well as other benefits for agriculture such as nitrogen fixation, are an important potential part of this dietary shift. However, food production and consumption do not exist in isolation of each other, meaning that an increase in demand needs to be supported by an increase in supply (as well as availability and affordability). Similarly, an increase in production needs to be able to stimulate an increase in demand if that demand is not already present.



What are beans?

- **Legume** – The term legume refers to a plant that is part of the diverse Fabaceae, or Leguminosae, family. Many leguminous plants produce edible seeds (which are commonly referred to as legumes), although non-seed pod producing varieties also exist, including alfalfa and clover.
- **Pulses** – A pulse is any edible dry seed harvested from plants of the legume (Leguminosae or Fabaceae) family. Pulses are a relatively diverse subgroup, including dry beans, dry peas, lentils, chickpeas, and lupins, amongst others. Edible legume seeds harvested immature and/or consumed as vegetables, such as green beans (*Phaseolus vulgaris*), and those used for oil production, such as soy (soya) beans (*Glycine max*), are not formally considered to be pulses.¹¹ These types are discussed as ‘beans’ within this report for the purposes of building a complete picture of the UK’s ‘bean’ trade flows, and because of their use in the production of alternative protein products.
- **Beans** – Beans are a subgroup of edible seeds harvested from leguminous plants. When dried for consumption beans are classed as pulses. In more general use, the term bean is used to refer to both dry beans (pulses) and beans that are harvested when immature (e.g. green beans).

This report describes UK demand and supply of plant-based alternatives, for human consumption, and the role of beans. The aim is to provide a better understanding of the current and potential future demand for, and supply of, beans and how this fits into a broader shift to plant-based foods.

This report includes:

- Analysis of the public commitments being made by caterers on plant-based foods, and where beans fit into this.
- Analysis of the wider demand trends in the UK for plant-based foods, and where beans fit into this.
- Analysis of the current UK production levels of beans.
- Analysis of the current UK import levels of beans.



Key findings

We find that, while UK demand for plant-based foods is on the rise, this is concentrated around highly processed alternatives to meat rather than demand for minimally processed beans. We do not find evidence of a rapid increase in demand for minimally processed plant proteins such as beans and other pulses.

Major caterers have a range of commitments related to plant-based foods in their menus, but do not have specific commitments around increasing demand for beans, let alone UK-produced beans. It may be that an increase in demand for beans is implicit in their plant-based targets, but this remains an assumption to be tested.

UK demand for beans is low and concentrated around baked beans, but we produce very small numbers of beans and, of these, a significant proportion are varieties used in animal feed or to be exported.

There are signs of innovation around beans in the UK, with investment in processing facilities, but these appear to be fairly isolated initiatives.

As already understood in this project, we import large quantities of beans from other countries such as the US and Canada.

The characteristics of navy beans make them a viable protein source for plant-based meat substitute products. Navy beans are ranked well for their protein concentration, protein digestibility and flavour (flavourless preferred for use in alternative protein products), but commercial stages and global crop volume production are highlighted as key limiting factors for their growth as a plant protein source.¹²

The opportunity for change represents a classic case of thinking across the food system rather than focusing on one issue in isolation. There is a clear opportunity to investigate how multiple benefits could be brought to the UK food system as a whole, and specifically for example to commitments for net zero, by shifting our production of, and demand for, UK beans at the same time. By linking supply and demand and ensuring that the essential processing facilities are in place, UK production and consumption of beans could increase in tandem. We find this coordinated effort to be lacking at present, acting as a barrier to change. Additionally, increasing UK bean production also represents an important contribution to sustainable agriculture via crop rotations due to their role in nitrogen fixation. This co-benefit for farmers could further increase the opportunity to marry demand and supply.

Key insights

Demand insights

- **The UK alternative protein market has experienced a boom in recent years and is projected to continue grow into the future, although the specific trajectory of this market remains unknown.** National Diet and Nutrition Survey data shows that the proportion of UK individuals consuming plant-based alternative foods increased from 6.7% in 2008–2011 to 13.1% in 2017–2019.¹³ Demand for plant-based alternative food offerings from retailers and fast food chains suggests potential responsiveness of consumers to plant-based offerings from caterers.



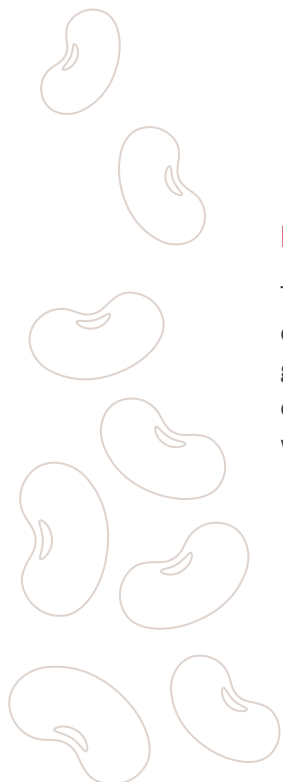
- **Increased demand for alternative proteins has not yet translated into demand for minimally processed plant proteins.** Average UK pulse, bean, seed and nut consumption only increased from 1.3% to 2.2% between 2008 and 2019 and demand for minimally processed beans may not be necessarily strong.¹⁴ However, with consumers potentially looking more and more for healthy and sustainable food options, any negative connotations associated with ultra-processed plant-based alternatives could provide an opportunity for less processed products such as beans.
- **The inclusion of beans within the menus of caterers, including those serving public sector institutes, may be a key gateway for increasing consumption of UK-grown legumes.**¹⁵ The sustainable diet and carbon reduction strategies of the UK's major catering firms overwhelmingly demonstrate shifts towards more plant-based menus. Theoretically, beans are well placed to be incorporated into new plant-based recipes, however barriers to demand for caterers and consumers such as preparation requirements remain.

Supply insights

- **Big label brands are developing bean-based product ranges, driven by consumption trends.** Brands such as Heinz and Tesco have expanded their product ranges to include whole bean-based products. This has likely been driven by increased demand for easy to prepare, less processed plant-based protein sources. These types of products may reveal an intermediary between unprocessed and ultra-processed bean products which appeal to consumers.
- **Medium and long-term challenges need to be overcome for development of the UK alternative protein sector and for use of UK-grown beans as a primary alternative protein ingredient.** Food sector stakeholders highlight lack of focus on plant protein in UK farming and processing infrastructure as limitations on the UK plant-based sector.
- **The price of beans impacts their attractiveness as an ingredient in alternative protein products.** Price is a key barrier to mass-market demand for plant-based products. Price represents a key factor influencing consumer food purchasing behaviour. Faced with a desire to keep product prices low, food manufacturers also favour low cost plant-based protein sources such as soy. Expanding domestic production and processing of beans may offer a strategy for reducing costs, through economies of scale and shorter supply chains.

Next steps

The next phase of research will focus on understanding the real world perspectives of stakeholders involved in the value chain: caterers, wholesalers, processors and growers. The focus will be on understanding opportunities and barriers to growth and on innovations that might facilitate an increase in supply and demand of UK beans, in what format, and where investments might be necessary.





The catering sector is focused on plant-based

Caterers are increasing plant-based offering and are committed to reducing carbon emissions

The scaling of UK beans is in part dependent upon the demand for beans coming from the public and private catering sectors. The sustainable diet commitments of the UK's national catering industry provide insights into how demand for plant-based protein sources is developing.

Within the UK, there are many different independent caterers providing services to schools, as well as other public sector institutions and private sector clients. We have assessed the relevant commitments and actions taken by five major contract caterers who dominate much of the market, supplying food services to schools, businesses, and public sector operations. These caterers are: Aramark, Compass Group, Elior, ISS and Sodexo. We believe they are representative of the market but acknowledge that smaller caterers may have different commitments, in some cases more advanced, in others less advanced. Our subsequent interview phase with caterers will help us to bring more 'real life' experience to this. As it stands, our desktop research is summarised below. Table 1 summarises the sustainable diets and carbon reduction commitments of the five major contract caterers.

Plant-based commitments

Assessment of the targets and sustainable dietary strategies of these caterers, based on publicly accessible information collated by The Food Foundation¹⁶ as well as research into the work being done by WWF and collaborative initiatives such as Peas Please and Cool Food, reveals that all five caterers are committed to pivoting their menus and food offerings towards more plant-based options. A common theme is attention to the percentage of vegan and vegetarian meals offered.

Some formal commitments to reducing red meat consumption and increasing plant-based meal offerings have been established. For example, Elior has committed to reducing beef consumption by 40% by 2024. Aramark previously committed to reducing the quantity of red meat sold during 2021 by 5% and are now committed to making 30% of their main dishes vegan or vegetarian. Similarly, in 2021 ISS committed to at least 25% of their new recipes being plant-based, primarily to improve the nutritional credentials of their meals. As part of their net zero transition plan, Sodexo is also committed to increasing the number of plant-based meals sold, and to increasing the proportion of their recipes that are plant-based to 33% by 2025. Commitments such as these reflect caterers' understanding of the need to integrate plant-based meal options into their core offerings, with this partly spurred on by increasing consumer demand for plant-based products, so called clean eating trends, and initiatives such as Meat-free Mondays and Veganuary.^{17,18}



Commitments specifically related to increasing the consumption of plant-based proteins are not sector wide, however. Two caterers have disclosed specific, timebound public commitments to increasing plant protein consumption so far. Compass Group has committed to increasing plant-based protein uptake, aiming to achieve a 25% switch to plant-based proteins by 2025 and a 40% switch by 2030. Elixor has committed to substituting carbon intense proteins for plant-based alternatives, with an ambition to reduce carbon emissions by 12% per meal by 2025. Sodexo UK and Ireland additionally recognise the need for lower carbon protein recipes within their net zero transition roadmap but do not have an official public commitment to achieving this. Despite lack of formal commitments from other major caterers, these commitments and the wider industry-wide shift towards plant-based options inherently suggests the potential for growth in demand for plant-based proteins. The commitments of caterers to creating nutritionally balanced, plant-based meals also suggests that the inclusion of plant-based protein sources will become a necessity.

Carbon reduction commitments

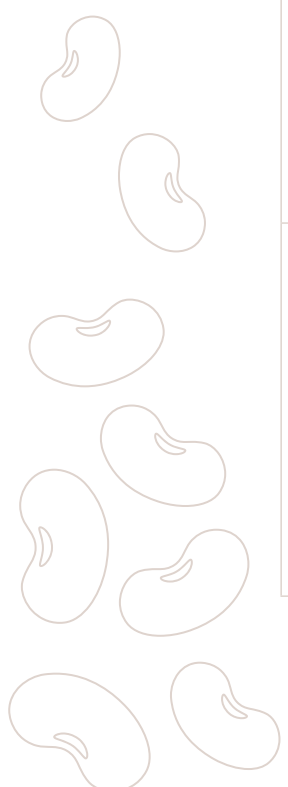
Reducing meat consumption is widely regarded as being necessary to achieve national and sub-national net zero commitments. The UK Climate Change committee have advocated for a 20% reduction in meat and dairy consumption by 2030 in order for UK emissions reductions to align with the UK's Net Zero Pathway.¹⁹ Meanwhile, nationally significant initiatives are advocating for dietary shifts towards higher consumption of plant-based foods and substantial reductions in the consumption of animal derived foods, including a 50% reduction in meat and dairy consumption by 2030.^{20,21} Caterers, restaurants, and other food retailers are responding and are increasingly considering their food offerings in the context of carbon emissions and carbon reduction commitments. This has potentially significant knock-on effects for caterer's demand for plant proteins. Elixor and ISS are leading the sector regarding food offering focused carbon reduction plans. As mentioned, Elixor is committed to reducing carbon emissions per meal by 12% by 2025 (compared to a baseline of their 2020 scope 1, 2 and 3 emissions), primarily through the promotion of vegan and vegetarian dishes and a reduction in beef consumption. ISS is committed to reducing the greenhouse gas emissions from food served by 25% by 2030. Synergies between environmentally sustainable diets, health, and climate action appear to be playing a significant role in driving demand for low carbon, plant-based protein sources across the UK catering sector.

At present, the sourcing of UK-grown ingredients does not appear to be central to caterers' commitments. There are some mentions of increasing local sourcing, such as within Sodexo's UK and Ireland Net Zero transition plan, however overall such commitments are absent or, if present, vague and nonspecific. This may be due to a current lack of awareness of the potential benefits of UK sourcing. Communicating the benefits of UK-grown and processed produce such as beans could be central to securing private sector demand. It is additionally important to note that no caterers appear to have specific commitments to increasing use of bean or pulses within their meal offerings.



Table 1: Summarisation of the sustainable diet commitments of the five major contract caterers operating in the UK

Caterer	Internal sustainable diets commitments	Carbon commitments	Engagement with sustainable diet industry initiatives
Aramark	<p>Increasing percentage of plant-based meals - 30% of meals vegan/vegetarian</p> <p>1200+ new vegan products and menus launched for Veganuary 2020.</p> <p>Plant-forward menu approach has increased fruits, vegetables and whole grains 9% while reducing red meat 5%.</p>	Aramark Northern Europe: Net Zero by 2050 including scope 1 & 2 and selected scope 3	
Compass Group	<p>25% switch towards plant-based proteins by 2025 and 40% switch by 2030</p> <p>50% reduction in food waste by 2030</p> <p>Peas Please Pledge target of increasing vegetable sales by 15%</p> <p>Committed to sourcing 70% of meat, dairy, and vegetables from regenerative agriculture sources by 2030</p>	<p>Carbon neutrality in Scope 1 & 2 direct emissions by 2030</p> <p>Climate Net Zero across value chain by 2050</p>	<p>Peas Please Pledge</p> <p>Veg Power supporter (Eat them to defeat them campaign)</p> <p>Members of the International Food Waste Coalition (IFWC) board</p>
Elior	<p>25% reduction in food waste by 2025</p> <p>40% reduction in beef consumption by 2024</p> <p>40% of Elior's UK recipes are vegetarian</p>	Committed to reducing per meal emissions by 12%	<p>Veg Power supporter (Eat them to defeat them campaign)</p> <p>Have supported Public Health Responsibility Pledges</p>
ISS	<p>Health and Well-Being Strategy launched 2020 - increasing fruit and vegetables in meals by 10%; promoting more plant-based ingredients.</p> <p>50% reduction in food waste by 2027</p>	<p>Net Zero emissions by 2040</p> <p>25% reduction in greenhouse gas emissions from food served by 2030</p> <p>UK & Ireland: Net Zero scope 1 & 2 emissions by 2030</p>	Peas Please Pledge



Caterer	Internal sustainable diets commitments	Carbon commitments	Engagement with sustainable diet industry initiatives
Sodexo	<p>33% of plant-based recipes by 2025</p> <p>50% reduction in food waste by 2025</p> <p>Development of 'Green & Lean' meals (vegetables, grains, pulses; no more than meat; responsibly sourced)</p> <p>2030-2040: Increase local sourcing of products and services</p>	Sodexo UK & Ireland: reduce GHG emissions by 55% by 2030. Net Zero by 2045	Peas Please Pledge Veg Power supporter (Eat them to defeat them campaign)



Consumer demand is shifting

Consumers are shifting towards plant-based diets, but plant-centred diets remain low at the population level

The scaling up of UK beans through catering opportunities is ultimately dependent upon the reception of and demand for bean-based meals by consumers served at catered institutions. YouGov data suggests that 14% of UK adults identify as flexitarian, 8% as vegetarian/pescetarian, and 3% as vegan.²² Although, figures on flexitarianism are inconsistent, partly attributable to varying definitions of what exactly constitutes a flexitarian diet. Major players in the food industry are anticipating increases in the consumption of vegan and vegetarian products; Sainsbury's predict that 25% of the UK population will be vegetarian by 2025,²³ and have recorded a 65% increase in sales of plant-based products year-on-year.²⁴ Overall, data suggests that plant-based offerings may be increasingly welcomed within catered situations. However, as YouGov survey results suggest, uptake of plant dominated diets across the total population remains limited.

In regard to consumer demand for unprocessed beans and pulses, data is relatively lacking. Domestic consumption of very minimally and minimally processed beans (see Table 4) and other legumes in the UK is considered to be far below that of other European countries such as Spain. Data from the UK's National Diet and Nutrition Surveys indicates that the contribution of beans, pulses, nuts and seeds to total daily dietary intake only increased by 0.9% between 2008–2019.¹³

Demand for alternative protein products is high

Data on the demand for highly processed alternative protein products overwhelmingly shows that demand has grown rapidly in recent years.^{25,26} Alternative protein products include products such as plant-based meat substitutes which are formulated to mimic animal derived products. In this section of the report, we examine the alternative protein market, including the apparent drivers that have supported the success and expansion of the sector, and the lessons that can be learnt from this for the successful scaling of UK beans. We additionally take stock of how beans currently fit into the alternative protein sector as an ingredient and how they could be further incorporated into the future, providing an alternative route for increased consumption of UK grown beans.

Plant-based alternatives to meat and dairy now represent the fastest growing trend in the UK food sector.²⁵ UKRI define alternative proteins as proteins “produced from sources that have low environmental impact”, which “augment livestock protein sources or offer an alternative to meat and dairy protein sources”, and that “directly or indirectly address 13 out of 17 UN Sustainable Development Goals (SDGs)”²⁵. As alluded to in this definition, alternative protein products do not necessarily completely replace animal protein sources within the diets of consumers.



The substantial growth in demand experienced in the UK alternative protein market is largely attributed to increased purchases by individuals who identify as flexitarian [semi-vegetarian] or who want to reduce their meat consumption without eliminating it completely.²⁷ Recent figures suggest that between 14% (from YouGov as mentioned²²) and 23% of the UK population now identify as flexitarian.²⁸ Available data does not yet associate increased sales of alternative proteins products with a reduction in purchases of meat products; although between 2008-2019, average UK meat consumption per capita has reduced from 103.7g to 86.3g per day.¹³

Alternative Protein Demand

Environmental concerns

Among the top considerations of consumers choosing plant-based protein alternatives is environmental impact.²⁹ Polling has revealed that 55% of British people see environmental sustainability as influencing the food they choose to eat (41% a “fair amount”, 14% “to a large extent”).³⁰ Alternative protein industry stakeholders recognise increased consumer awareness of the environmental impacts of the foods they eat and market products accordingly to capitalise upon this demand driver. Reflecting this, carbon labelling is being increasingly utilised within the alternative protein sector to communicate the environmental credentials of products.^{31,32}

Health

Consumer awareness of the health benefits associated with more plant-dominated diets has additionally increased in recent years. The Covid-19 pandemic highlighted the role of obesity in non-communicable health-related diseases, contributing to greater consumer interest in so-called clean eating and clean-label products.¹⁷ Meat substitute products are generally perceived as healthier alternatives to conventional meat products, with this supporting demand. However, there is doubt over the extent to which demand from health-conscious consumers will continue into the future. Meat substitutes generally constitute ultra-processed foods (UPFs), a food category sometimes associated with a lack of nutrients and fibre, and high levels of sugar, salt and/or fat.

Consumer knowledge of the negative health connotations of these foods has the potential to reduce demand growth in the future. This may necessitate changes within this market, and/or open opportunities for more wholefood, less processed plant protein sources such as beans and pulses. There may be a commercial opportunity to highlight the health positive attributes of less processed plant-based protein sources such as beans.²⁵ However, it is important to note that taste also represents a hugely influential driver of demand²⁹, with desirable meat substitute flavours currently being achieved using additives and masking agents.²⁵ This is especially true for bean-based products to hide earthy flavours found to be disliked by consumers.²⁵ Reduction in processing and the inclusion of additives may represent a significant barrier to restructuring product ranges in response to health concerns.



Price

Consumer demand for novel food products such as alternative proteins is elastic and highly responsive to price. Research indicates that 64% of individuals who have reduced their purchases of plant-based food products would be more likely to choose plant-based options if there were more frequent sales and/or lower prices.³³ Price as a barrier to plant-based purchases is especially vulnerable to being exacerbated by economic circumstances. The current cost of living crisis may have the potential to dampen growth of the alternative protein market due to the close link between consumer behaviour and price.

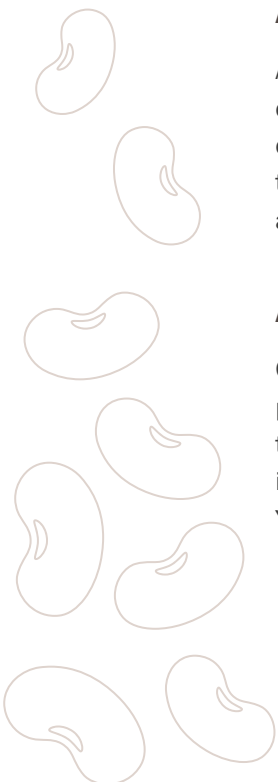
Currently, plant-based meat substitute products are on average priced higher than conventional meat products.²⁷ Literature suggests that there is currently a price premium of approximately 32% for plant-based burgers compared to conventional meat options in the UK.²⁷ However, the long-term influence of price on the alternative protein sector is not necessarily clear. This is because consumers do not always respond as predictions anticipate. For example, during Veganuary plant-based product purchases have been found to increase by the greatest amount in low-income areas (64% increase in average weekly unit sales, compared to UK average increase of 57%), despite economic thinking generally predicting the opposite.¹⁸ Moreover, the attitudes of sector stakeholders give reason to expect a reduction in the plant-based vs meat price disparity over the coming years, potentially removing price as a barrier to demand. Beyond Meat, a producer of plant-based meat substitutes, has publicised ambitions to underprice conventional animal oppositions within at least one of their product categories by 2024.³⁴ The development of supermarket own-brand product ranges is also contributing to closing the price gap between alternative protein products and meat, with all 10 major UK supermarkets now having own brand vegan ranges.¹⁷ Research additionally shows that the average price of conventional meat products rose by 7% between 2020 and 2021, compared to the average price of alternative plant-based products only increasing by 1%.³⁵ Moving into 2023/24, the dependency of livestock production on agricultural inputs may mean that inflation driven price increases continue to close the price gap further.

Animal welfare

According to YouGov polling, 70% of vegetarians and 89% of vegans report their disagreement with how animals are farmed and killed as a contributing factor to their dietary choices.³⁶ In general, animal welfare concerns appear to be continuing to drive the shifts of UK consumers to plant-based diets, likely contributing to demand for alternative protein products, as well as whole food plant-based proteins.

Age

Consumer age is an additional influential factor affecting the uptake of alternative protein products. YouGov polling commissioned by the Eating Better alliance indicates that 63% of 11–18 year olds consider the environment and climate change as the most important issues facing the UK, and 29% want to reduce their consumption of meat.³⁷ Younger generations also appear to display greater willingness to try new foods.³⁸



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Growth in alternative proteins

The alternative protein market continues to grow, supported by product diversification

The global alternative protein sector has undergone rapid development and diversification, with the global market now projected to be worth \$27 billion by 2027.²⁵ Within the UK, Europe's largest alternative protein product market²⁹, meat and dairy alternatives are extensively available. Supply-side foodtech innovations have encouraged and facilitated sector growth through rapid expansion of product ranges.^{24,39} Sales of plant-based alternatives within the UK are now estimated to exceed £1 billion, with year-on-year growth anticipated across product categories, although how this actually develops remains to be seen.²⁵

Meat substitute products represent a key offering of the alternative protein market, alongside dairy and egg replacements. Meat substitutes are formulated to be analogous with conventional meat products, mimicking their taste, texture, and appearance.⁴⁰ Plant-based concentrates and isolates are the most commonly used protein sources used for creation of these products. The production of meat analogues using cellular cultures and fermentation processes is also a prominent area of development. However, products produced via these processes remain in early stages, with regulatory barriers being faced before they can make it onto consumers' plates. Alternative meat products mimicking red meat, such as Beyond Meat's Impossible Burger represent the most dominant product type.²⁷ Year-on-year sales of meat substitutes such as this are anticipated to grow by 30%.²⁵ Continued growth is being supported by diversification of product offerings, with a broad portfolio of options now available. Product diversification and range expansion is thought to be central to continued growth of the market.⁴¹

The structure of the alternative protein market

The alternative protein sector is fragmented, with market share split among many small-medium enterprises (SMEs) and increasingly major meat and dairy manufacturers.²⁵ SMEs within the sector have focused on technological product innovations, enabling them to offer novel products and product ranges as a strategy to gain market share.²⁵ Major meat and dairy manufacturers are also now key players within the global market, having been attracted as new entrants to the sector by shifting consumer preferences and the market disruption initiated by SMEs. Key players within the global market include Beyond Meat (US), Impossible Foods (US), Kellogg Company (US), Tyson Foods (US), JBS SA (Brazil), Unilever Group (UK).³⁹ Meat substitute products are additionally gaining traction in the fast-food sector, primarily through partnerships of franchises with alternative protein companies.³⁹ For example, McDonald's launched its first meat substitute product in 2021, the McPlant, co-created with Beyond Meat.⁴²



Table 2: Dominant UK alternative protein (meat substitute) manufacturers

Parent Food Company	Brand	Meat substitute products	Primary protein source ingredients used
Beyond Meat Inc.	Beyond Meat	Burgers, chicken-style burgers, ground mince, sausages, meatballs, 'chicken' burgers	Pea protein, rice protein, fava bean protein
Hain Celestial	Linda McCartney Foods	Sausages, burgers, meatballs, meal kits, chicken-style burgers, chicken-style nuggets/bites, sausage- and pulled pork-style rolls	Soy protein concentrate, wheat protein
Monde Nissin Corporation	Quorn	Sausages, ground mince, meatballs, steak strips, chicken-style tenders/nuggets, chicken style pieces, chicken-style fillets, vegetarian roast, deli slices	Mycoprotein, textured wheat protein
THIS (Plant Meat Limited)	THIS	Sausages, bacon, meatballs, chicken-style pieces, chicken-style tenders/nuggets, lamb-style kebabs	Soy protein concentrate, textured soy protein, pea protein isolate
Pilgrim's Food Masters	Richmond	Sausages, bacon, chicken-style pieces, burgers, meatballs	Textured soya protein, textured wheat protein, soya protein

Plant protein sources

The selection of plant protein sources by alternative protein product manufacturers involves several considerations. Important attributes include protein content and quality, allergenicity, consumer perception and familiarity, taste and texture, availability, and cost.¹⁵ Currently, ingredients imported to the UK, such as soy, wheat and pea constitute the primary ingredients of alternative protein products (Figure 1).²⁵

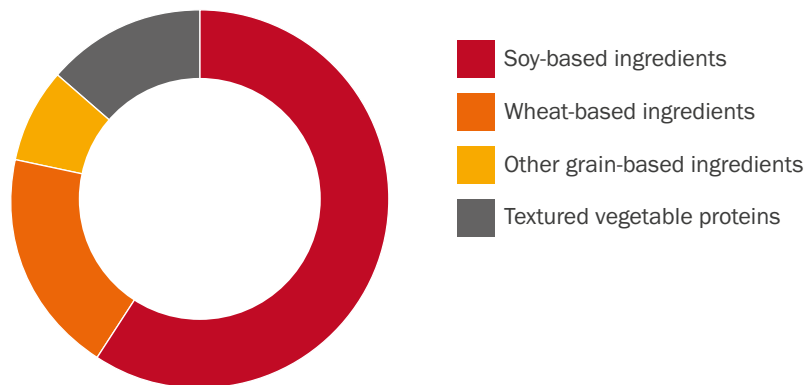
Table 2 reflects the dominance of these plant protein sources, used in the forms of concentrates and isolates within some of the most popular alternative protein products. Data compiled by The Good Food Institute identifies soy, wheat and pea as all having high functionality for use in alternative protein products, having low costs per kg of protein (<\$2–4), and as being in advantaged stages of commercial development.¹⁵ The production scale of these crops is high, facilitating sufficient volumes and comparatively low prices compared to alternative plant proteins.



In comparison, navy beans rank poorly in terms of commercial development (currently only at the research and development stage) and global crop volumes.¹⁵ Fava beans and mung beans have thus far been explored to a greater extent as commercial protein sources and are included as secondary ingredients in many meat substitute products popular in the UK market. Neither fava beans nor mung beans rank more favourably in terms of protein content, protein quality, or flavourlessness (a preferred attribute for use in meat substitutes) than navy beans¹⁵, suggesting potential for navy beans to undergo further commercial development.

It is additionally worth noting potential consumer dissatisfaction with currently dominant soy-based products, given concerns surrounding the environmental impacts of soy, allergen risks, and GMOs. This, combined with brand desires to maintain environmentally friendly reputations, may drive diversification of plant protein sources utilised for alternative protein products, opening the door to alternatives such as beans.⁴³ At present, low crop volumes and limited crop availability likely present the greatest barriers to food industry investment in navy beans specifically.

Figure 1: UK Meat Substitutes Market Share, by plant protein source, 2021. Source: [Fortune Business Insights](#).



Market investment

Data published by the Good Food Institute reveals that £212 million in investments were raised by UK-based alternative protein development companies in 2021 – representing an ca. 290% increase compared to the previous year.⁴⁴ The alternative protein market is well positioned to benefit from the interest of ESG investors, given the low carbon and land use credentials of products. Recent years have also seen an increase in investor engagement with the food industry on shifting away from animal-based proteins and investment in plant-based alternatives, often led by initiatives such as FAIRR (Farm Animal Investment Risk and Return). Investments of this type may be of importance to consider when evaluating opportunities for the scaling of UK-grown bean products.



Supply-side dynamics

The alternative protein sector has been crowned as an opportunity for UK-led disruptive innovation, supporting a transition to lower carbon UK diets.²⁵ However, numerous short, medium, and long-term supply side challenges exist, limiting materialisation of this reality.²⁵

The UKRI observes that transitioning to shorter supply chains, with increased use of domestically produced crops relies upon investment in UK farming infrastructure, including the development of new crop varieties suited to plant protein extraction and UK growing conditions.²⁵ However, it is acknowledged that shifts of UK agriculture towards plant proteins require policy interventions and cannot be achieved through commercial enterprises alone. Industry stakeholders currently evaluate the UK plant-based protein sector as experiencing market failure.²⁵ This is attributed to issues inherent to volume driven commodity supply chains; processors are reluctant to invest in processing infrastructure before primary producers increase crop production, but primary producers will not increase production until a market for their commodity is guaranteed.²⁵ Low domestic plant-based protein self-sufficiency and cost pressures mean that the alternative protein sector remains dependent upon imported products and ingredients.

Alongside increased domestic production of protein-rich food crops, key to the development of a competitive UK-based alternative protein sector is the existence of efficient plant protein extraction and processing facilities. Evidence suggests that midstream industry actors are responding to perceived increased demand and expected future demand for plant-based alternative protein products within the UK. Projects currently under development reflect plant-based food manufacturers' ambitions to shorten supply chains while scaling up production as a combined strategy to maximise cost savings.⁴⁵ For example, Plant & Bean are constructing a plant-based food manufacturing facility in Lincolnshire. This will be Europe's largest factory of its kind and fast-growing demand for plant-based meat substitute products is considered the primary driver behind Plant & Bean's investment.⁴⁵ Regarding beans and other pulses, initial desk-based research indicates the existing presence of bean/pulse processors within the UK, including Askew and Barret Ltd and ADM. New bean/pulse processing facilities have also been established in recent years, including a bean dehulling facility operated by Frontier Agriculture⁴⁶ which is positioned to supply food manufacturers with domestically produced and processed beans. Despite these developments being somewhat isolated, they can be taken to suggest some level of investment in bean and pulse processing within the UK.



Supply side

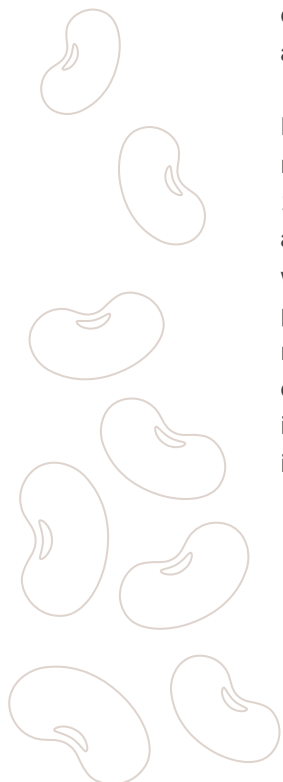
UK production, consumption, and international trade of beans

The previous section of this report examined the UK market for highly processed alternative plant-based protein products. Despite the poor health outcomes beginning to be linked with the consumption of ultra-processed products, this sector has boomed in recent years and is projected to continue to grow into the future. The success of alternative protein products and a potentially saturated marketplace may represent a challenge for scaling consumption of beans and bean-based products. Alternatively, the drivers behind the growth of the alternative protein market, such as shifts in consumer preferences, may reveal opportunities for increasing bean consumption. This section examines available data on the production and processing of beans for both processed and unprocessed bean markets within the UK. Our subsequent interview phase with caterers and sector stakeholders will clarify the structure of the UK bean value chain and help us to identify the UK-based bean processors currently operating.

UK Bean Production and Processing

The UK legume crop market is poorly defined, and sources vary in the data (such as bean types) they incorporate. Within this report we have included multiple sources of data to build a holistic picture of the market. Official data reporting on edible bean crops within the UK are available through the Defra 'Agriculture in the United Kingdom' report.⁴⁷ Defra crop figures estimate that field beans (also known as fava or broad beans) covered 188,000 hectares of the UK in 2021.⁴⁷ With a projected yield of 3.7 tonnes/ha, this equates to a production value of approximately £160 million.⁴⁷ Typically, UK bean crop productivity amounts to 2–6 t/ha⁴⁸, depending upon cropping location and growing season conditions. Compared to 2020, field bean production increased by an estimated 28% in 2021 to an estimated 694 tonnes, attributable to 3.5% higher cropping area and significantly higher average yields.⁴⁷ Overall, the UK only produces two varieties of pulses at substantial scale – field beans (or fava beans, *Vicia faba*) and field/green peas (or large blue peas, *Pisum sativum*). Apart from these, none of the edible legume varieties (pulses) mentioned within this report are grown commercially at any scale within the UK.

In the UK, pulse/legume crop production is significantly lower than that of alternative, non-protein rich crops such as oilseed and cereal crops. In 2020, wheat crops covered 1,387,000 hectares with a final production value of ca. £1,544,000,000, whereas peas and beans (some of which grown for livestock feed) covered only 233,000 hectares, worth ca. £142,000,000 in value.⁴⁷ This disparity is partly attributable to agricultural policies/schemes which have historically favoured public funding for research into non-legume crops.¹⁴ Low levels of funding have been available for research focused on enhancing the genetic variability and diversification of pulse crops, specifically.¹⁴ Annual investments into non-legume crops are in the billions of dollars, while total annual investments into pulses are approximated to only amount to around \$175m.¹⁴



Legumes are increasingly being valued as cover crops integrated into environmentally conscious farming, such as regenerative agriculture. Given the nitrogen fixing and other beneficial properties of legume crops, increasing legume production based on benefits such as these may represent an unexplored avenue for increasing production.

UK bean production and domestic consumption

As previously mentioned, the availability of UK bean and legume market data is limited. Here we present data from a range of sources based on data available to build an overarching view of the UK bean production and consumption. In reflection of data availability, data presented here is segmented into different key types of beans grown and/or consumed in the UK. Following on from this, data sourced from the UN Comtrade database is presented to give insight into UK imports and exports of different types of beans.

Fava, or broad/field, beans (*Vicia faba*) are grown as winter and spring varieties in the UK, with suitable climatic conditions facilitating fava beans as being the predominant bean grown domestically.⁴⁹ Fava beans are used for domestic animal feed and are exported for human consumption in regions such as the Middle East and Africa.¹⁴ Egypt represents a significant market, importing approximately 200,000 tonnes of fava beans grown in the UK annually.¹⁴

Fresh, or common/green, beans (*Phaseolus vulgaris*) are grown for human consumption in the UK, with harvests being retailed as fresh or frozen produce.⁴⁹ However, the UK climate is not especially well suited to growing this variety and domestic consumption is higher than UK production, with a greater quantity of fresh beans being imported than grown domestically.⁴⁹

White beans (*vigna spp.*, *phaseolus spp.*) are processed from imported ingredients within the UK. The export value of the UK was \$2.25m in 2021, equating to 4.35m kg.⁵⁰ The UK import value was significantly larger at \$160.7m, representing 47.86m kg.⁵⁰ For example, baked beans (navy beans pressure cooked in tomato sauce) represent a highly popular product consumed in the UK. At present, market data indicates that during 2021 the UK imported \$98.56m worth of baked beans (ca. 110.29m kg).⁵¹

UN Comtrade Trade Data 2021:

The UN Comtrade database provides valuable data on UK bean imports and exports. Here we present this data to give an overview of the UK's bean imports and exports. Figures presented include trade for both human consumption and livestock feed. The types of beans included in these figures are listed in Table 3.



Major importers of beans to the UK:

In terms of trade value, the UK's top suppliers of beans (including soy beans) in 2021 were: Brazil (\$394,399,097); Canada (\$218,560,891); USA (\$92,298,028); Kenya (\$69,804,672); and the Netherlands (\$29,580,366). The dominance of Brazil as a trading partner can likely be attributed to imports of soy beans to the UK, primarily for use in animal feed. Canada is widely recognised as a key exporter of various bean varieties, including navy beans used within baked beans, to the UK. US bean exports to the UK likely comprise of both soy beans as well as other common varieties used for human consumption such as navy beans. Kenya's prevalence as a top bean exporter to the UK is likely attributable to the significant production of runner beans and green beans nationally.

Overall UK bean imports and exports:

Data available on UK bean imports and exports reveals a substantial trade deficit in beans, with imports of beans significantly exceeding exports. This trade deficit is present whether only common bean (*Phaseolus vulgaris*) varieties or all bean varieties for which trade data is available are considered. Large volumes of soy beans are imported to the UK for use in livestock feed so data is presented with and without the inclusion of soy beans. Table 3 provides a detailed breakdown of the bean varieties for which the UN Comtrade database provides UK import-export data.

Common Beans (shelled, unshelled; fresh, chilled or frozen; cooked or uncooked)

- Imports: \$368,659,041
- Exports: \$9,673,998
- Trade deficit: -\$358,985,043

All beans* (excluding soy beans)

- Imports: \$623,438,507
- Exports: \$124,571,573
- Trade deficit: -\$498,866,934

All beans* (including soy beans)

- Imports: \$1,963,356,495
- Exports: \$126,833,583
- Trade deficit: -\$1,836,522,642

*Bean types included presented in Table 3



Table 3: The categories of edible beans present within the UK bean market (produced, imported and exported). Sourced from UN Comtrade Database

Bean type	Common name	UK imports (US\$), 2021	UK exports (US\$), 2021
<i>Vigna spp.</i> , <i>Phaseolus spp.</i>	Various bean varieties, including cowpea (black-eyed) and mung beans	368,659,041	9,673,933
<i>Vigna mungo</i> , <i>Vigna radiata</i>	Black gram bean, mung bean	39,579,520	4,264,803
<i>Phaseolus</i> or <i>Vigna angularis</i>	Red (adzuki) beans	2,011,794	57,119
<i>Phaseolus vulgaris</i>	Dry beans including navy, kidney, pinto black turtle, anasazi.	193,370,228	2,696,950
<i>Vigna subterranea</i> or <i>Voandzeia subterranea</i>	Bambara beans	313,343	30,339
<i>Vicia faba var. major</i> & <i>Vicia faba var. equina</i> , <i>Vicia faba var. minor</i>	Fava beans (broad beans & horse beans)	8,577,506	10,7571,242
<i>Glycine max</i>	Soy (soya) bean	231,167,398	2,262,280

Bean-based product market

Within the UK, the majority of volumes of minimally processed whole legumes and pulses, such as dried, canned and bottled formats (see Table 4) are distributed via the major supermarkets. Online specialty retailers/stores such as Hodmedod's additionally contribute. As mentioned earlier within this report, new legume processing plants are being established within the UK, reflecting some level of investment in infrastructure within the sector. Further important mid-sector value chain actors are likely to be identified through engagement with caterers and other actors during the subsequent interview stage of this project.

Despite aligning with shifting consumer preferences for healthy and environmentally sustainable foods, very minimally and minimally processed legumes and pulses (see Table 4) face barriers to consumer uptake, primarily revolving around preparation requirements such as overnight soaking. In 2019/2020, on average, UK consumers purchased 79g of beans in sauce (baked beans) versus 24g of other canned beans and pulses per week⁵², reflecting consumer preferences for somewhat processed, flavoured options. However, on average, per person purchases of canned beans have marginally increased between 2006-2019, from an average of 15g to 24g, with the amount of baked beans also marginally decreasing over the same period.⁵²

Given the apparent restrictions on demand for very minimally processed beans, international ingredient manufacturers have developed new forms of ingredients including pastas, flours and crackers, although UK engagement with these remains low.¹⁴



In the UK market, ready-to-cook bean-based convenience foods are entering the market, taking advantage of consumer preferences for quick and ready-to-eat products that resemble conventional food items they are familiar with. Table 5 presents some ready-to-cook bean-based convenience options popular with UK consumers and their primary ingredients. More generally, pre-cooked whole beans are also incorporated into ready-to-eat options such as wraps, salads, and ready-made meals, products which allow brands to offer products that are perceived as both fresh and convenient.⁵³

The Processors and Growers Research Association suggest that supplying pulse-based meals to public sector institutions in combination with education on their health and environmental benefits is key to significantly shifting consumption trends.¹⁴ Engaging caterers to better understand their requirements and preferences surrounding unprocessed beans and bean-based products will enable us to identify the validity of such ideas, as well as the current barriers to uptake and opportunities for upscaling.

Table 4: Types of bean-based products available, categorised by levels of processing





Type	Description	Image	Level of processing
Dried beans	Beans are conditioned to remove foreign material and unwanted (e.g. broken) beans. The beans are then cleaned, dried, and packaged. Dried beans must be soaked and cooked before consumption.		Very minimally processed
Canned/jarred beans	Beans are conditioned, cleaned, blanched, tinned, and heated to high temperatures once tinned to make them shelf stable. Canned/jarred beans are pre-cooked and ready-to-eat.		Minimally processed
Processed bean products	Processed bean products are produced from dried beans or pre-cooked beans. Preparations methods vary by product type but tend to be more involved than for canned/jarred beans. Example products include: flavoured tinned beans, bean flours, bean pastes, bean burgers and refried beans.		Processed
Highly processed bean products	Beans are further processed into products with specified desirable characteristics. Additional ingredients such as starches, flours, thickeners, stabilisers, emulsifiers, flavourings and oils are added to achieve the desired characteristics.		Ultra-processed



Table 5: Example bean-based ready-to-cook products available in the UK

Brand (Company)	Product	Primary ingredients
Heinz (Kraft Heinz Company)	Original Bean Burgerz	Mixed Beans (13%, Haricot and Cannellini), Wheat Gluten, Mushrooms (11%), Onions (11%), Sunflower Oil, Vegetable Protein (Wheat Gluten, Wheat), Tomato Paste (7%), Tomatoes (5%)
GoodLife (GoodLife Foods)	Spicy Bean Burger	Beans (22%) (Red Kidney Beans, Cannellini Beans, Haricot Beans), Wheat Flour, Onion (14%)
Tesco	Plant Chef Spicy Bean Burger	Vegetables (32%) [Onion, Pepper, Carrot, Sweetcorn], Wheat Flour, Red Kidney Beans (8%), Haricot Beans (8%)
GoVeggie (Galaxy Nutritional Foods, Inc.)	Spiced Bean Burgers	Red kidney beans (13%), Onion, Cannellini beans (9%)



Future analysis

The next phase of research will focus on understanding the real world perspectives of stakeholders involved in the value chain: caterers, wholesalers, processors and growers. The focus will be on understanding opportunities and barriers to growth and on innovations that might facilitate an increase in supply and demand of UK beans, in what format, and where investments might be necessary.



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Errata

Correction to data for white beans on page 22: this paragraph has been amended from the previous version – September 2023.





BeanMeals
Thinking beyond the can

About the BeanMeals project

Thinking beyond the can: Mainstreaming UK-grown beans in healthy meals (BeanMeals)

BeanMeals starts with the question of how to promote healthy diets through bean-based school meals and works backwards through the supply chain to bean processing and growing. Crossing research disciplines with innovation topics, the project aims to determine how best to bring about systemic innovation for food system transformation, as well as analyse the health, environment and enterprise benefits of the transformed system.

The research team pulls together expertise from UK research institutions, spanning areas such as food systems, agroecconomics, systemic innovation, food policy, legume breeding, public health and behaviour change. It is led by a team based at the University of Oxford and includes researchers from the University of Hertfordshire, University of Liverpool, University of Warwick, University of Hull. The project also work in partnership with Leicestershire County Council, Leicester City Council, 3Keel, Food for Life; Campden BRI; and other local and national stakeholders.

The project is part of UKRI's Transforming UK Food Systems Strategic Priorities Fund (SPF) Programme. This £47.5 million programme aims to fundamentally transform the UK food system by placing healthy people and a healthy natural environment at its centre.

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Partners



Joanne Craven
Serious gaming and research communication

