



**WARWICK**  
THE UNIVERSITY OF WARWICK

## **Growing British**

- a strategy paper for  
promoting fresh produce  
production in the UK

**Growing British** – backing UK production would add an extra £0.5 billion in direct GDP contributions to the UK economy per year by 2032 as the growing industries transition to net zero carbon and the National Food Strategy<sup>1</sup> is delivered. This strategy green paper charts how economic, environmental, and nutritional benefits can be realised in a vibrant fresh produce sector.

# KEY OPPORTUNITIES

**£3.2 billion direct GDP contributions from the UK fresh produce industry in 2032**, compared with £2.7 billion in 2020<sup>2,3</sup>.

Up to **£126 billion of long-term economic benefits from a healthier, more sustainable UK food system** of which increasing fruit, vegetable and fibre consumption is a core component<sup>1</sup>.

**£21 - £105 million benefit in annual carbon savings** if net zero is achieved in UK fruit and vegetable production<sup>(4)</sup>.

**131,000 potential direct permanent jobs** in the industry in 2032<sup>3</sup> compared with 115,000<sup>2</sup> in 2020.

---

The Fresh Produce industry (fruit and vegetables) has the potential to increase its direct contribution to national GDP from £2.7 billion in 2020<sup>2</sup> to around £3.2 billion in 2032<sup>3</sup> before inflation. Approximately half of UK growers plan to increase production and productivity<sup>5</sup>; this paper explores opportunities to realise this.

The number of permanent jobs has the potential to increase from 115,000<sup>2</sup> in 2020 to 131,000 in 2032<sup>3</sup>. This has the potential for large increases in skilled employment in rural and peri-urban communities, contributing to the UK's Levelling Up and Regeneration Agenda<sup>6</sup> as the industry welcomes a new age of technology.

These projections are based on matching domestic production with the National Food Strategy independent report<sup>1</sup> recommendation of a 30% increase in fruit and vegetable consumption in the UK diet. The opportunities identified in this paper are based on 50% of this increase in fruit and vegetable consumption being home produced - currently the UK is 57% self-sufficient in vegetable production<sup>2</sup>.

The recommendation for increasing fruit and vegetable consumption was made as part of a set of dietary recommendations in the National Food Strategy. When these dietary changes are combined with changes in land use and tax reforms estimates of net benefits to the UK economy could total up to £126 billion<sup>1</sup>.

The industry must respond to government and consumer pressures to meet sustainability targets<sup>7</sup> presenting both challenge and opportunity. The diverse nature of the horticulture sector means that opportunities differ, but with correct framework, planning and tools, this sector can achieve net zero<sup>8</sup>.

This industry, known for innovation, must respond to government and consumer pressures to meet sustainability targets.

Growth in the Fresh Produce sector is most squarely aligned with the national interest when compared with other primary food production sectors<sup>1</sup>. A sustainable portfolio of strategic support is needed if the UK Fresh Produce industry is to continue to thrive and grow. The sector has a history of underinvestment and needs a viable research and innovation programme as part of a long-term strategic vision. This green paper outlines many opportunities which can be developed by the sector to benefit the UK with sufficient support.

# INTRODUCTION



In the UK, we produce some of the best fresh produce in the world. Yet fruit and vegetables remain our largest trade gap in the food sector with an export value of £0.85 billion compared with an import value of £10.46 billion, giving a trade gap of £9.61 billion in 2021<sup>7</sup>. Although imports will always be an important part of supply, due to our relatively short growing season and consumer desires for exotic produce, the stark imbalance in trade is an indication of our heavy reliance on other countries for the supply of fruit and vegetables. This vulnerability is recognised in the UK Food Security Report 2021<sup>10</sup>. For example, since 1988, our home production supply of vegetables has dropped from 82.7% to 55.6% and for fruit it is just 16.3%<sup>2</sup>.

As diets shift and climate vulnerable countries increasingly struggle with food production, there is abundant scope for increasing production and resilience in the domestic fresh produce sector whilst helping the government respond to the

targets set out in the National Food Strategy<sup>1</sup> and deliver on its commitments to levelling up the United Kingdom and building back greener<sup>10</sup>. This paper will outline the economic advantages of an expansion in horticulture, the barriers to that expansion (notably labour, margins & research and innovation), with recommendations on how to address these constraints.

**“Fresh produce is the sector of primary food production where growth most squarely aligns with the national interest”**

(National Food Strategy<sup>1</sup>)

# EXECUTIVE SUMMARY

## **Economic development and levelling up:**

The UK Fresh Produce industry directly contributed £2.7 billion to the UK economy in 2020<sup>2</sup>, which is 10% of total agricultural output despite it occupying less than 1% of agricultural land<sup>11</sup> and receiving less than 1% of the UK governments agricultural budget<sup>12</sup>. It also provides an estimated 115,000 people with permanent employment<sup>2</sup>. Average horticultural output from 2010 to 2019 increased 27% compared with the previous 2000 to 2009 period average<sup>11</sup>. The trend in value for the UK's field vegetables is for a 17% rise per annum<sup>2</sup>. Combine this healthy growth with a positive shift in dietary preferences for fruits and vegetables (Section 2 below), we assess that home production value could grow to £3.2 billion in direct GDP contributions, with the direct provision of 131,000 full time jobs by 2032. Skilled jobs will ensure rural and peri-urban communities thrive, therefore supporting the aims of the Government's levelling up strategy for narrowing the UK's geographical inequality gap. UK growers need to be able to modernise and expand if we are to provide a greater supply of home-grown fruit and vegetables.

## **Opportunities include:**

- Increasing domestic production to substitute for fresh produce imports.
- Facilitating investment by improving access to business improvement funds, thereby promoting productivity gains through the adoption of new technologies including automation and robotics, and improvements in infrastructure for small scale producers.
- Expanding the sector's capacity to meet the growing alternative protein market.
- Ensuring growers can achieve sustainable margins and receive a fairer share of their produce value by addressing pressures from retailers, empowering the Groceries Code Adjudicator and facilitating shorter supply chains.
- Increasing the capacity of the seasonal worker scheme to ensure no crops go unharvested.
- Attracting new entrants by fostering an environment for entrepreneurs and those looking to develop skills in commercial horticulture.
- Using the industry to upskill rural and peri-urban communities to provide jobs that can be meaningful and diverse.
- Improving biosecurity and maximising Integrated Pest Management as a strategy for environmentally friendly pest control whilst retaining a core ability to rapidly respond to pest and disease threats.
- Creating a unified voice that represents the industry's best interests with a coherent, joined up R&I funding pipeline to link grower experience with discovery science.

## **The National Food Strategy<sup>1</sup> and the Government Food Strategy<sup>13</sup>:**

Fruit and vegetable consumption has a huge part to play in climate resilience and human health. At current rates, it is predicted that by 2035/36 the NHS will be spending 1.5 times more on diabetes alone than they currently spend on all cancer treatments<sup>12</sup>. Obesity is a further problem resulting in costs of over £6 billion to the NHS alone<sup>15</sup>. People who are ill work less and have a lower life expectancy. To tackle this, one of the central recommendations from the National Food Strategy independent report is to increase our fruit and vegetable consumption by 30% by 2032. This presents British Growers with opportunities and challenges as recognised in the Government Food Strategy<sup>13</sup>.

### **Opportunities include:**

- Ensuring that the nation's fruit and vegetable production increases by at least 30% to match growth in consumption and maximising on initiatives to buy seasonal, buy local, buy British.
- Contributing up to 13% of the NHS target to extend healthy life expectancy in the UK by 5 years by 2035<sup>16</sup>.

### **Environmental benefits and transitioning to Net Zero:**

Climate change is the defining crisis of our time and UK agriculture is currently contributing 11% of the UK's territorial GHG emissions<sup>17</sup> and must transition to net zero<sup>18</sup>. Additional emissions arise from energy for protected crop production, transport, and post-harvest storage and overall, fruit and veg account for 2.5% of the UK's GHG emissions<sup>19</sup>. The National Farmers Union has set a target to reach net-zero GHG emissions in England and Wales by 2040<sup>18</sup>. Furthermore, our edible crops face unprecedented threats from both new and established pests, at a time when research and development is contracting due to the loss of the AHDB horticulture levy. Under the Environmental Land Management Scheme (ELMS) new and existing opportunities to realise sustainable benefits must be explored and incentivised to help the government deliver on its 25 Year Environmental Plan<sup>20</sup> and commitment to Build Back Greener<sup>21</sup>.

### **Opportunities include:**

- Increasing outputs of home-grown fruit and vegetables on a small footprint leaves plenty of space for carbon capture crops, rewilding and biodiversity.
- Increasing controlled environment agriculture to maximise production, whilst minimising water footprints, waste, pollution, and seasonality.
- Meeting the Climate Change Committee target for agriculture.
- Improving biosecurity and maximising Integrated Pest Management as a strategy for environmentally friendly pest control whilst retaining a core ability to rapidly respond to pest and disease threats.
- Wide engagement in the Courtauld commitment to help reduce food waste, emissions, and to protect water along the supply chain. Targets for improving storage and handling of fresh produce should also be included in this.
- Government and industry working together on a realistic peat replacement strategy.
- Collaboration between the public and private sector for heat decarbonisation in the sector and improved understanding of carbon emission calculations in the industry.
- Acceleration of the Government's vision for climate and nature to facilitate the uptake of soil and biodiversity improvement strategies.
- Develop alternative plant nutrition strategies to reduce GHG emissions.
- Developing strategies to improve efficiency and reduce GHG emissions associated with handling and storage of horticultural produce.
- Supporting, expanding and adopting organic and agroecological practises which contribute to the economic, health and environmental aims outlined in this paper.

### **A strategy for Research and Innovation:**

Historically, horticulture as a sector has lost direct UKRI and DEFRA funding. Arable, fisheries and livestock are all supported by core funding to Institutes<sup>22</sup>. Funding for infrastructure (e.g. the AgriTech centres) does not deliver a structure of longer-term, sustainable support, and projects funded by Innovate UK and related schemes (Farming Innovation Platform etc) benefit specific businesses, and do not universally deliver research for the public good. The loss of the AHDB Horticulture levy for R&I is a further severe blow to the future competitiveness of the Fresh Produce sector, for which success underpins all the beneficiaries noted above. A 10+ year strategic support plan is needed for the sector.

### **Opportunities include:**

- Creating a unified voice that represents the industry's best interests with a coherent, joined up R&I funding pipeline to link grower experience with discovery science.
- Extending essential core infrastructures such as genetic collections, pest monitoring and forecasting services, and converting the best public good projects funded by AHDB Horticulture to national infrastructure projects.
- Maximising innovation and best practice to help UK growers adapt to environmental change and realise trading opportunities as diets adapt to the EAT-Lancet goals<sup>23</sup>.

### **The Government Food Strategy<sup>13</sup> and fresh produce**

Key measures announced in the Government Food Strategy 2022 show that the fresh produce sector is recognised as a key source of healthier, high quality tasty food and drink and is ripe for growth. There is a budget committed to the Farming Innovation Platform and to UKRI. There are measures to address the supply of workers and for addressing the skills needed across the food system. There is also a recognition of the need for a sustainable, affordable and nature positive food system which will meet the nation's climate change and Net Zero commitments. The boosting of horticulture is encouraged.

The fresh produce sector is seen to offer an increasing number of options for sustainable growth and the TIAH is developing as a well-positioned resource for supporting the skills needed for new and changing businesses. The expansion of controlled environment growing is being encouraged along with support for the rapid development of automation in horticulture. Encouragement is also given for the development of protein crops, for example.

### **A Horticulture Strategy**

There is a declaration that the government will work with growers to develop a world leading horticulture strategy for England (food policy is devolved). This is to be welcomed. To achieve greater fresh food sustainability and at the same time, Net Zero will need not only world class innovation, but support for rural businesses, training appropriate for an enthusiastic, dynamic but changing workforce, fair and transparent trading legislation and an agreed model for the future sustainability of specialist research in the sector. Fresh food production fixes carbon, provides vital nutrition year-round, contributes rural employment and helps the nation manage our natural environment. The sector deserves a strategy which recognises its importance and commits resource to help it deliver. We hope this green paper contributes to the national policy and commit it for discussion and consideration.

# CONTENTS

<b>9</b>	1. Economic development and levelling up
<b>17</b>	2. The National Food strategy
<b>19</b>	3. Environmental benefits and transitioning to net-zero
<b>24</b>	4. Research and Innovation strategy
<b>28</b>	5. Closing statement
<b>29</b>	Authorship



## 1. ECONOMIC DEVELOPMENT AND LEVELLING UP

Fresh produce production in the UK in 2020 was valued at £2.7 billion<sup>2</sup>, with vegetables (£1,670) and fruit (£1,045 million), employing an estimated 115,000 permanent workers<sup>2</sup>. The year-on-year trend is for a rise in direct value for vegetables against a backdrop of a declining market share for home-produced produce (82.7% in 1988, whereas in 2020 the UK was 55.6% self-sufficient in all vegetables and only 16.3% for all fruit)<sup>2</sup>.

The total area under fresh produce production (2020) was 152,595 Ha<sup>11</sup> against a total for agricultural land of 17.3 million ha, making the percentage of agricultural land dedicated to fresh produce less than 1% of the total. Yet, fresh produce output contributed 10% of the total value of agricultural output<sup>11</sup>. Fresh produce production is highly efficient. Such land efficiency compared to other forms of farming has historically led to far lower contributions from the Rural Payment Scheme/ Countryside Stewardship Scheme per unit of production value and it remains to be seen how the new ELM scheme will address this.

The sector suffers from being frequently overlooked by the agrochemical companies because its diversity of crops and practices is unattractive under the current pesticide approvals process. There are no nationally funded Research Institutes catering for the fresh produce sector. Against these and other disadvantageous trading and innovation circumstances, the sector remains vibrant and creative. It is this commercial energy that is ready to capitalise on opportunities for growth as they arise.

The pace of change in farming is likely to accelerate as agritech industries respond to climate change obligations, changing dietary preferences in the UK, increasing competition from biotechnology industries. There is also more pressure on imports of fresh produce due to Brexit and rising fuel costs, making the transport of fresh, perishable produce more vulnerable.

New technologies for growing fresh food all year round are advancing. Brexit and other international challenges also make the supply of seasonal workers unreliable. Small scale organic and agroecological horticulture is expanding with a sustained demand, driving a rise in the number of SME farmers.

All these factors present opportunities for growth of the UK's fresh produce sector, for businesses small and large, adding to the spread of commercial diversification in the countryside, the advance of highly skilled jobs into rural and semi-urban areas, and the conversion of semi-productive open field farms to concentrated horticultural production, whilst at the same time releasing land for carbon capture etc. With over half of UK edible produce growers looking to increase production and productivity over the next five years<sup>5</sup> we stand on a springboard of opportunities for enhancing our vitally important British Fresh Produce industries.

### 1.1. Economic growth

#### Opportunity 1: Import substitution and expanding home production to realise the Government Food Strategy

- Expand the production of field grown fresh produce to substitute for imports from countries that have climatic conditions similar to our own. For example, in 1990 the UK grew far more brassicas than in 2020 (785 vs 486 thousand tonnes, a drop of almost 40%), and in 1990 the UK was 90% self-sufficient in lettuce (which includes protected lettuce), a figure that has dropped to 33% in 2020<sup>2</sup>.
- Expand controlled environment agriculture (CEA). CEA needs energy-efficient solutions, but offers season-free, space-efficient, high value domestic production. A good example of this would be substitution for mushroom imports in which the UK is only 47.5% self-sufficient. Other examples are recognised in the Government Food Strategy<sup>13</sup>.
- Anticipate the rising costs of irrigation water: approximately 76% of our water consumption through the fresh fruit and vegetable supply chain is from abroad<sup>24</sup>. Many of the countries from which we import our fresh produce are water scarce. An example is the import of strawberries from Spain. For certain crops, given that the growing environment is becoming more challenging in some of our supplier countries, it becomes more efficient and more environmentally friendly to expand UK production rather than import.
- Extend the marketing season by improving storage strategies: improved storage strategies for fresh produce can reduce the need for imports. One example is the extension of Gala apple storage, where research into storage management practices has enabled customers to purchase them into July, whereas previously no UK Gala were available past April. This is also true for vegetable growers who look to extend their season for leeks and Brussels sprouts by 1-2 months using controlled atmosphere storage<sup>25</sup>.
- Facilitate agricultural conversion. As the balance of land use in agriculture changes, it makes sense to grow plants and trees for carbon capture and nature friendly landscapes on marginal and less accessible lands and establish specialist, accessible fresh produce production units on small areas of the most suitable land and on brown field sites, keeping skilled jobs in rural and peri-urban areas.  
**A 50% increase in horticultural production would still require less than 2% of current agricultural land.**
- Recognise and support Community Supported Agriculture (CSA) in the UK. This innovative farming model offers a partnership between farmers and consumers where the responsibility, risks and rewards of farming are shared. Consumers typically commit to buy produce for a whole season from agroecological farms, providing a whole range of benefits such as access to local fresh produce, farmer - community connection, community and volunteer wellbeing, and environmental public goods. Funds to allow the CSA to deliver start-up support, training and resources and ensuring schemes, loans, capital grants and land are available to small scale farmers are important. This type of model could contribute not only to import substitution but also physical, mental and environmental health. There is a large opportunity and interest for small market gardens to be implemented on agricultural land, for example, for expanding peri-urban horticulture (Fringe Farming) and for direct selling through farm shops and veg box schemes - COVID-19 Veg box scheme report<sup>11</sup>.

- Continue to encourage and support clean energy generation as an integral deliverable from CE agricultural developments and encourage the wider use of farmed land and farm buildings as suppliers of energy<sup>26</sup>. Nevertheless, where on-site generation remains impossible, agriculture and horticulture need energy at competitive prices to ensure fresh food production continues year-round.

To deliver this opportunity we need to develop a holistic strategy for the fresh produce sector to encourage investment and underpin change.

### **Opportunity 2: Improve productivity gains by enabling access to business improvement funding**

Business improvement funding is essential for development and implementation of the technologies necessary for increasing productivity. For example, access to adequate labour with appropriate skills has long been accepted as a key barrier to growth in UK horticulture<sup>27</sup>. Automation of labour-intensive activities is one solution. Amongst the barriers to the implementation of automation in the fresh produce sector are: a lack of financial resources; the need for more rapid advancement of technological developments; and differing retailer demands<sup>11</sup>. Nevertheless, global AgriFoodTech investment continues to break records, reaching a staggering \$31 billion in 2020, up more than 8x from 2012 (Agfunder). The time is right to facilitate investments by the fresh food industries.

- Facilitate business improvement funding. The automation review<sup>27</sup> itemised the challenges of securing investment funding faced by growers. We endorse Recommendation 4, a national review on financial and fiscal support for investment in fresh produce production facilities and training. The Farming innovation Platform (FIP) helps some seed innovation and expansion in the sector, but its resource is spread across the widest branches of agriculture, fisheries and forestry. Little reaches horticulture and fresh produce. If fresh produce is to grow to secure the expanding accessible market with a value of an additional £0.5 billion per annum, more directed financial assistance is needed.

- Promote investment in automation and robotics. For some fresh produce crops labour makes up the majority of production costs (e.g. salad onions, asparagus, lettuce). On the other hand, there are new production units in which production, harvest and packing is entirely automated (lettuce). Therefore, developing and introducing new technologies, automation and robotics generates new, high technology jobs in rural communities as well as securing sustainable, predictable production of fresh commodities. Current fiscal arrangements do not seem to be suitable for widespread adoption targeted for the horticultural industry.
- Small-scale producers benefit from investments in infrastructure. The Food Sense Wales small grant pilot awarded £5k grants to five eligible vegetable producers who increased their sales of vegetables on average by 74.5% (when grants were spent effectively), benefitting an extra 79 families a week with a veg box and having positive impacts on the local community and environment. The Welsh government have now released a small grants scheme for horticulture with £3000 available for each business, to act as a fund for the diversification of an existing agricultural business or for an entirely new enterprise, creating new rural opportunities.
- Introduce a small grant schemes of £5k to £10k in the rest of the UK for small scale fresh produce growers to encourage them to invest in equipment and infrastructure such as packing sheds, tractors and polytunnels. Allow the scheme to be managed by a third party that has a good grasp of small producers. This will enable a flexible approach that can for example facilitate the purchase of second-hand equipment which is not allowed in the current Defra grant schemes.

### **Opportunity 3: Expansion in production of alternative plant protein sources**

The UK alternative protein market experienced a 290% rise in investment in 2021 and ING economics estimated that the plant-based alternatives market in the EU and UK will rise from £3.9 billion in 2019 to £6.6 billion by 2025 (ING Research, 2020). Strategic investment in protein crops (pulses and legumes) suited to the UK climate will promote uptake, adoption of more sustainable crop rotations, more environmentally friendly nutrient practices etc. and allow the UK fresh produce industry to capitalise on this new market.

The National Food Strategy<sup>1</sup> has estimated that 10,000 factory roles and 6,500 farming jobs will be created through the alternative protein industry. An example of this can be seen with the establishment of the new Plant and Bean<sup>28</sup> factory for plant-based 'meat' protein in Lincolnshire, with estimates of up to 500 new jobs being created as a result. The overall market for alternative plant products grown in the UK has the potential to greatly reduce our environmental impact, promote consumer choice and create thousands of new green jobs.

The recent (2022) funding call "Farming Futures R&D Fund: Sustainable farm-based protein" is welcome and appropriate.

- Promote the development of a greater number of varieties of legumes and pulses for commercial farming in the UK climate. For example, the 2BHealthyGB<sup>29</sup> project is breeding new varieties of popular imported beans, such as the haricot, so that they are now adapted for growth in the UK climate. These beans are excellent sources of prebiotic dietary fibre, iron, and protein. The aim of the project is to create a closed-loop food system where everyday ingredients like these beans that are high in protein can be grown locally and involve consumers as active participants in the system.
- The alternative proteins market can provide alternative incomes for rural economies (homemade ice creams and cheeses from plants) and peri-urban economies (fermentation and other production units).

- Fava beans (broad beans) in the UK are mainly sold as animal feed, however the retailer Hodemedod<sup>30</sup> has been selling them with success as human food for a number of years. Fava beans may also provide plant protein for use in products such as meatless burgers, replacing soy. Over 17 years, researchers in Denmark have addressed the two main barriers to widespread fava bean use by eliminating the gene product which triggers allergies and adapting the flavour for the human palette<sup>31</sup>. Meelunie<sup>32</sup> are opening a large processing facility in Denmark for fava beans. Facilitating this use of fava beans would improve current value, expand the use of a nitrogen fixing crop and provide an alternative to soya bean which is associated with the widespread destruction of tropical ecosystems.
- Increasing consumption of pulses adds fibre to the human diet, contributing to improved health and nutrition<sup>1,23</sup>.

### **Opportunity 4: Ensure that growers can achieve sustainable margins**

A huge problem in the industry is the pressure on business margins<sup>27</sup>. Input costs such as fertiliser, labour, energy, and growing media are all rising, whilst retail prices of fruit and vegetables have remained static for years. Tight margins mean little chance to reinvest, making expansion in production and implementation of environmental measures extremely difficult. If the industry is to grow and thrive, new measures to ensure that growers see a fair share of the value of their produce is required.

- Measures to address the pressure on growers created by competition between big retailers are needed. The drive for cosmetic perfection and supply contracts that bind growers into wasteful resource expenditure sap enthusiasm for business investment. A more flexible approach to retailer crop specifications and supply contracts is needed to ensure growers are not harshly penalised for events out of their control. The Groceries Supply COP and the office of the Groceries Code Adjudicator need continued support. There is a consultation pending. The sector hopes that the powers assigned to the GCA over market trading practices, fair trade and transparency are strengthened.

- Ensure that new trade deals with other countries do not allow fresh produce into the country that is not held to the same strict health and environmental requirements that UK producers abide by. These imports can undercut and undermine both value and confidence in UK produce. We welcome the statements in the Government Food Strategy that it will uphold the high quality of home-grown fresh produce.
- Facilitate shorter, farmer focused supply chains e.g., food hubs for both organic and non-organic, community supported agriculture, veg box schemes, market gardens etc. These ensure low food miles, enhance local communities, provide rural employment and help diversify our countryside.

#### **Opportunity 5: Increase efficiency of supply chains to reduce waste to help make fresh food accessible to all**

- Retailers across the board need to have broader crop harvesting specifications. Differing retailer demands mean that production and harvesting processes can vary for the same crop. Manual labour is needed to cater for these different demands as it is not economically viable to produce multiple different automation systems for the same type of crop. For example, different retailers require different lengths of leek. Wider acceptabilities will promote the development and adoption of automation in horticulture which will increase efficiency and reduce waste.
- Develop artificial intelligence (AI) technology to create a more efficient and less wasteful food supply chain<sup>33</sup>. Projected estimates of the AI-enabled precision farming market suggest a value of £9.81 billion globally by 2025<sup>34</sup>. AI can help reduce storage times, travel mileage, gluts and shortages by improving operational excellence. If fresh food is produced more closely to demand, for example predicting diet and shopping patterns according to weather, holiday periods etc., the energy used in unnecessary transport and storage can be reduced, food will be fresher and more nutritious and waste minimised.

**£3.2 billion direct GDP contributions from the UK fresh produce industry in 2032, compared with £2.7 billion in 2020<sup>2,3</sup> if productivity is aligned with an increase in consumption.**



## 1.2. Expanding employment opportunities

Historically the UK has relied upon the free movement of EU workers for seasonal labour. Almost all of the 70,000 seasonal workers employed for fruit picking and vegetable harvesting are from eastern Europe. The Migration Advisory Committee reports that 99% of all seasonal agriculture workers are from the EU. This seasonal labour is provided predominantly through the Seasonal Worker Scheme which has become increasingly necessary due to the falling number of workers with EU settled status and the challenging nature of domestic recruitment.

The government has announced extensions to the seasonal worker scheme, providing 40,000 visas in 2022<sup>13</sup>. This falls short of the NFU's call for 60,000 workers, and industry bodies at the National Fruit Show calling for 60,000 - 80,000. In 2021 crops remained unharvested - £500,000 of produce in Kent was not delivered due to driver shortages; in Cornwall, 271 million daffodils were left to rot. The most recent UK Labour in Horticulture Survey (Q3 2021) reported that 44% of horticultural growers had a labour shortfall<sup>5</sup>. The recent Horticulture Business Survey found availability of labour to be one of the most important factors considered by growers when making plans to increase production and productivity<sup>5</sup>. The addition of the ornamental sector into the scheme will provide further pressure on worker availability.

Emphasis moving forward is on automation, often because domestic recruitment has proven to be difficult for the industry. Domestic recruitment is impeded by poor transport links to urban populations, antisocial work patterns and conditions, the temporary nature of employment and the sheer size of labour force required. Automation offers opportunities to change this and head in the direction of long-term positive change, but this will take time because automation is not yet ready to fulfil industry needs. Meanwhile, we must recognise the need for overseas seasonal labour.

### **Opportunity 1: Seasonal Worker Pilot**

- Increase the visa extension to at least 60,000 to ensure that crops do not go unharvested in 2023 and beyond. According to Barfoots' Managing Director, soft fruit alone takes 30,000 workers.
- More clarification and warning must be given to growers on issues such as seasonal workers minimum wages considering the effects that this has on fresh produce growers' profitability in this era of inflationary pressures.
- Draw policy lessons from the New Zealand Recognised Seasonal Employer (RSE) scheme which has been recognised as one of the most successful interventions, providing a triple win for migrant workers, their sending countries and for New Zealand.

### **Opportunity 2: Attracting new entrants**

- Encourage support for The Institute for Agriculture and Horticulture (TIAH) - agriculture and horticulture's professional body; "The home of skills and careers support, we will help people and businesses fulfil their potential and the industry thrive." TIAH will support the existing workforce adapt to the changing demands of buyers, consumers and automation via continual upskilling, and it will help attract a supply of new entrants into careers in the horticulture industries. It is important that a variety of pathways into horticulture are supported through TIAH, including organic and agroecological.

- Recognise, support, and develop the Horticulture Renewal Programme as a framework for supporting the recruitment, training and establishment of new growers and supporting existing ones. This framework contains actions based on successful case studies that can help to foster an environment which attracts and facilitates entrepreneurs looking to set up new businesses as well as providing meaningful, and diverse jobs for people motivated to participate in an attractive and skilled profession.

### **Opportunity 3: Retaining sector-specific expertise in research and innovation**

Many research projects carried out by institutions represented by the Fresh Food Research and Innovation Forum have been funded by the AHDB. Without this secure source of funding following the closure of AHDB Horticulture in April 2022, the capacity of this research work will be severely reduced and will result in the loss of experienced staff, facilities, resources, and training. Considering the detrimental effects this would have on the industry's research capabilities, it is vitally important that this capacity is not lost.

- Ensure that the expert horticultural knowledge of AHDB staff is not lost following the demise of AHDB horticulture. Many of these staff have worked within the industry for many years and have a deep understanding of it and its needs.
- Expertise in the growing community must continue to move forward. Continuing professional development needs to be encouraged to help maintain the impetus for innovation in the sector.
- Ensure that unique infrastructures and staff expertise which have been supported by AHDB projects are not lost. A new vision and strategy for funding R&I is essential.
- See Section 4 "Research and Innovation Strategy"
- The Agritech centres need to become more integrated into the wider fabric of the UK's fresh produce sector.

### **Opportunity 4: Developing skilled jobs in horticulture and exporting knowledge**

- There is an opportunity to export our horticultural skills and technology to other countries which could result in additional investment and jobs in UK horticulture.

### 1.2.1. Rural and peri-urban community renewal: levelling up

Typically jobs in rural areas are scarce, offer low pay and low skilled employment. It is vital that the UK sustains a flourishing agricultural sector with all its supporting trades. British growers support employment in the landscape. A strategy for support and growth needs to invest in people as well as technology.

In many cases training for new skills will be needed to be competitive in the industry and to draw expertise into rural and peri-urban areas (i.e., robotics and automation). A structure is needed to ensure that this training can lead to a necessary mindset and skills shifts in the industry. This will help businesses undertake effective personal evaluation of relevant innovations and technologies, as well as providing the technical skills to operate. Only by utilising funding effectively will businesses reach their full potential and rural communities can thrive. This is a crucial aspect of the Government's Levelling Up strategy - of narrowing the UK's geographical inequality gaps.

#### Opportunity 1: Upskilling

Government, industry, and training providers need to collaborate, identify, co-ordinate, and share best practice in skills delivery for horticulture. Jobs and training in rural and peri-urban areas are dominated by low skilled options. Horticulture offers careers and skills in these areas to help level up not only across the North/South divide, but also those living in the countryside with opportunities equivalent to those available in towns and cities.

A big cultural bias frames horticultural careers as low skilled. Increasingly it is highly skilled personnel who are needed to drive businesses forward. Growers want to increase their productivity by increasing the skills and competence of their workforce<sup>5</sup> making it time, now, to develop and implement an upskilling strategy that can help level up the UK.

- Working with TIAH to ensure alignment across the wider agricultural sector for expertise and career development as well as extend their remit to cover postharvest and storage. TIAH's activities will give staff access to a competency framework to highlight the skills and knowledge required



to perform certain roles and signpost them to existing training. In addition, individuals will be able to keep a record of their CPD activity which will include knowledge exchange as well as formal learning. This engages with the government's white paper "Skills for jobs: lifelong learning for opportunity and growth" and look for opportunities to develop training. This will add to and extend previous AHDB sector skills surveys, which have ceased since AHDB Horticulture ended. Once fully functional, TIAH will have the capability to support online special interest groups and have a matchmaking facility for mentors/mentees; support apprenticeship development; develop the competency framework as the base for all curriculums in the future.

- Welcome new skills and expertise into primary food production and promote the new age of automation in order for rural businesses to be viable and attractive as employers - promote new ways of working as career choices.
- The Horticulture renewal programme<sup>36</sup>, developed by the Land Workers alliance and Growing Communities, contains actions for training that would help upskill those looking to develop a career in SME horticulture.

**By aligning projections for increases in jobs with productivity, a further 16,000 full time jobs will be created<sup>3</sup>**



## 2. THE NATIONAL FOOD STRATEGY

Improving diet through increasing fruit and vegetable consumption would have a positive impact on the health of the nation and on the UK's environment. Although data are limited, any reduction in conditions such as diabetes, cancer and heart disease will reduce health and societal costs and improve health-related quality of life. Fruit and vegetable consumption is positively linked to increased levels of mental wellbeing, and it is known that depression is one of the major causes of disease burden in the UK. Diets low in fruit accounted for 10,066 premature deaths and approximately 210,000 disability adjusted life years (DALYs) in 2019. Diets low in vegetables accounted for 5935 premature deaths and approximately 98,000 DALYs<sup>1</sup>.

There are many issues surrounding diet choice which need to be addressed. The National Food Strategy<sup>1</sup> makes 14 recommendations for improving the UK's diet, health, climate and nature commitments. One of the central goals is to increase consumption of fruit and vegetables by 30% by 2032. This goal gives the UK fresh produce industry a clear opportunity, and it is noted that growth in the edibles sector is more squarely aligned with the national interest than any other sector of primary food production.

### **Opportunity 1: Provide better access to fruit and vegetables for consumers**

- Facilitate access of lower income families to fresh fruit and vegetables, possibly via tax collected from sugar and salt.
- Expand the healthy start scheme to encompass a higher income eligibility of £20,000 and children under the age of five to receive vouchers which can be spent on fruit and vegetables.
- Double the current level of funding for the School Fruit and Vegetable scheme with the money going directly to the schools with reforms to promote purchases of UK fresh produce.

### **Opportunity 2: Provide better education on the benefits of fruit and vegetable intake**

- Joint approach from Government and industry to promote seasonality of UK grown fresh produce.
- Support and develop innovations such as Nutritank<sup>37</sup>. This hub promotes healthy nutrition and lifestyles in medical education to healthcare professionals, students and the public.

- Trial a “Community Eatwell” project<sup>38</sup>, which would give GPs the option to prescribe fruit and vegetables with nutritional education and social support.
- Develop horticulture as a process throughout the curriculum. This could help bridge the clear disconnect between food production and food consumption that exists throughout the population.

### **Opportunity 3: Promote in-store interventions to encourage fruit and vegetable purchases**

- Promote in-store interventions to encourage fruit and vegetable purchases<sup>39,40</sup>. Little published data from the UK exists on fruit and vegetable interventions, specifically targeting sales, making it an exciting area for innovative pilots. The Peas Please<sup>41,42</sup> initiative want to encourage various trials to be included as part of their commitments.

### **Opportunity 4: Promote community gardening and allotment renewal**

- Studies have shown that people who engage in community gardening consume more fruit and vegetables on average than people who do not<sup>43,44</sup>. However, Britain has lost 65% of its allotment land since the 1960’s. Subsidy money could be used to buy suitable land to rent out as allotment space as well as campaigns to encourage people to grow crops, offering advice, training, free seeds, and encouragement<sup>45</sup>.

**Savings on healthcare and changes in land use in line with recommendations for future consumption of fruit and vegetables will contribute towards a long-term economic impact of £126 billion<sup>1</sup>.**



### 3. ENVIRONMENTAL BENEFITS AND TRANSITIONING TO NET-ZERO

Climate change is the defining crisis of our time and UK agriculture is currently contributing 11% of the UK total GHG emissions<sup>17</sup>. Fresh Produce provision accounts for 2.5% of total UK GHG emissions<sup>46,47</sup>, although most of these carbon costs are in transport and storage with a considerable contribution from the use of peat. We have estimated that the emissions penalty for increasing UK fresh produce production by 30%, plus the associated penalties in the supply chain<sup>4</sup>. There is a roadmap with excellent guidelines to help guide each part of the horticulture sector move production practices towards Net Zero<sup>48</sup> and a policy brief from the UK Climate Change Committee with evidenced reduction targets<sup>49</sup>.

The National Farmers Union has set a target across the agricultural sector to reach net-zero GHG emissions in England and Wales by 2040<sup>18,20</sup>. Consumers and retailers are also pressuring the industry to adopt sustainable practises. Food producers themselves are benefactors of curbing climate change which according to the IPCC will continue to have increasingly adverse impacts on global food production and supply.

Big changes are needed though. Since 2008, UK agriculture has struggled to decarbonise and the food system as a whole has done so at less than half the speed of the wider economy<sup>1</sup>.

Increasing the UK's production, productivity and consumption of fresh produce could have hugely beneficial impacts on health, economic development, and the environment<sup>1,49</sup>. The industry itself must adopt sustainable practises and transition to net zero and needs incentivisation. As growers begin to be rewarded by public money for producing public goods under the Environmental Land Management Scheme<sup>50</sup>, new and existing opportunities to realise it's aims must be explored and incentivised, whilst at the same time the barriers to its implementation must be addressed.

There will be inherent differences in some of the opportunities across the sector. For example, protected production demands approaches in energy decarbonisation that field vegetables will not. However, quite universally, growers lack profitability due to pressures on margins (see Section 1 on Economic development, above) and this acts as a huge barrier to those who want to invest in environmental improvements.

Furthermore, our edible crops are under unprecedented threats from both new and established pests at a time when the agrochemical arsenal is reducing. Loss of actives is driven by environmental gain, but control remains a priority need if we are to maintain and grow fresh produce profitably and safely in the UK. Biocontrol in all its guises needs support and encouragement, but research and development is contracting due to the loss of the AHDB Horticulture levy. This presents both challenge and opportunity for an industry known for its innovation. The horticulture strategy needs to realise what it will take to produce an environmentally sustainable and resilient sector that is well equipped to deliver on the 25 Year Environmental Plan<sup>20</sup> and commitment to Build Back Greener<sup>21</sup> whilst not compromising on production and productivity.

Achieving net zero in UK fresh produce production would provide social cost of carbon (SCC) benefits of between £21 and £105 million annually<sup>4</sup>. If net zero were to be achieved in the entire UK fresh produce supply chain, then this would provide SCC benefits of between £0.5 billion and £1.3 billion annually<sup>4</sup>.

### **Opportunity 1: Maximise Integrated Pest Management (IPM) as a strategy for environmentally friendly pest and disease control**

Pest, disease and weed control are significant concerns for growers. There is a need to advance the development and use of control strategies that rely less on synthetic pesticides, in particular Integrated Pest Management (IPM), thereby reducing adverse effects on the environment. IPM strategies are generally crop specific and at present few horticultural crops are close to having IPM strategies that effectively address all pest, disease and weed threats.

- Implement a core strategic programme that develops and promotes IPM for all fresh produce. Link this to “healthy food, healthy environment” food systems<sup>1,49</sup>.
- Promote plant breeding for resistance and tolerance across fresh produce. In the UK each £1 invested in plant breeding generated at least £40 in added value between the years 1980-2009<sup>52,54</sup>.
- Support gene editing alongside modern molecular selection and breeding technologies to accelerate crop improvement.

### **Opportunity 2: Improve biosecurity (Plant biosecurity strategy for Great Britain 2023 to 2028)<sup>55</sup>**

- Deliver on the 5 year plant biosecurity strategy to protect our plants.
- Ensure that additional long-term research funding is available in plant health research to gain better understandings of outbreak risks and effective interventions.

### **Opportunity 3: New R&D funding model - pest and disease control in a safe environment**

Despite the cessation of the AHDB Horticulture levy we must still be able to respond rapidly to identify and manage new and emerging pests which threaten the competitiveness of the industry. Examples include the research and dissemination of knowledge on how to manage spotted wing drosophila, tomato brown rugose virus and fusarium wilt.

- Devise funding stream as an alternative to the AHDB levy to cover emergency actions
- Retain surveillance funding and Knowledge Exchange (e.g. the AHDB Pest Bulletin) for the public good.
- (See Section 4 on funding, below).

### **Opportunity 4: Better encouragement for growers to improve soil health and biodiversity**

Soil organic matter content is low and declining in the UK. Increasing soil organic matter can contribute a host of benefits such as increased productivity, available water capacity, carbon sequestration, plus decreased erosion and runoff. Good practice can be encouraged by:

- Speeding up the introduction of land use improvement payments which so far do not do enough to meet the Government’s vision for the climate and nature.
- Expanding the scope of the Agricultural Bill to reward peatland restoration and measures to avoid leaching to help protect the environment and sequester more carbon.
- Adopting the policies outlines in the CHAP and UKCCC reports<sup>57,58</sup>.

### **Opportunity 5: Improve the efficiency and understanding of carbon emission calculations in the industry**

Few growers (29%) have active plans to reduce their GHG footprint<sup>5</sup> and only 15% of growers measure their GHG emissions, of which half do not believe they have tools to do so accurately. Of the 85% of growers who do not measure GHG emissions, the main reason is because they are unclear how to. This needs to be addressed<sup>57</sup>.

- Develop an easily understood carbon calculator that can be used as a standard across the grower industry. Many systems are in use currently. Standardisation will enable transparency in the system and allow for accurate benchmarking to help achieve the rate of change needed.

### **Opportunity 6: Develop alternative plant nutrition strategies to reduce GHG emissions**

For field crops in particular, greenhouse gas emissions (GHGe), dominated by nitrous oxide, are affected mainly by fertiliser inputs and soil cultivation. There is a need for coordinated research, linked to robust GHGe measurement to test a range of strategies to minimise these emissions. Strategies will differ by crop type, with root crops providing a particular challenge due to the difficulty of reducing cultivation. Approaches to be targeted for research include the following:

- Formulation of organic and mineral fertilisers, biostimulants and products with controlled rates of nutrient release.
- Fertiliser placement technologies, including drip fertigation to target the root zone, reducing waste, emissions and pollution of water sources.
- Improving the use of cover crops
- New fertiliser media derived from recovered nutrients, and new chemical additives or coatings to reduce nutrient losses.
- Breeding crop varieties with higher nitrogen and water-use efficiency.

### **Opportunity 7: Developing strategies to improve efficiency and reduce GHG emissions associated with handling and storage of horticultural produce**

The energy use and emissions associated with handling and storage of horticultural produce differs by crop type but for many is about one third or more of the total for crop production (CHAP & AHDB 2022<sup>56</sup>); for long-term stored vegetables it is estimated that 32% emissions are associated with storage and transport, while this rises to 44% for top fruit, even for vegetables that are sold immediately 16% emissions are associated with postharvest cooling. The UK needs to retain research facilities and expertise to address a range of issues.

- Approaches for energy efficient cooling systems, including in-field, with the potential to use locally generated solar power.
- Improving efficiency of temperature control during long-term road and sea transport, including improving air-flow patterns through design of freight containers, crates and retail packs.
- Improving energy efficiency of medium and long-term air and controlled atmosphere storage through store design and using crop monitoring to target storage regimes more accurately to the needs of commodities thereby minimising stress and associated quality.

### **Opportunity 8: Utilise and expand organic and agroecological practices**

Organic and agroecological approaches to farming have seen a sustained interest and demand and have a lot to offer towards improving the environment, economy and health. At present they represent a small percentage of the market, however they are in a position to expand and offer many solutions in line with environmental, economic and health goals.

- Investment and scaling of organic and agroecological farming systems.
- Use best practise of agroecological approaches, for example using agroforestry to plant small woodlands in the right place and integrate with crops as integrated agroforestry systems. This could increase tree planting, provide sustainable woodland products, benefit soil health and wildlife whilst creating more fulfilling job opportunities<sup>57</sup>.



### **Opportunity 9: Include fruit trees as part of the England Trees Action Plan (ETAP)<sup>58</sup>**

- Listen to the British Independent Fruit Growers Association’s call for government support to be given to orchard planting. This could be used as a contribution to the governments ETAP aims of tripling tree planting by 2024.

### **Opportunity 10: Addressing waste: saving carbon emissions and water along the supply chain**

It is estimated that 170,000 tonnes of fresh produce is wasted each year along the supply chain.

- Encourage all industry actors to sign up to the Courtauld Commitment<sup>59</sup> set out by WRAP to reduce food waste, cut carbon emissions, and protect water across the food supply chain. If targets are met by 2030, there could be an overall reduction of 50% in GHG emissions from the food supply chain and a food waste reduction of 800,000 tonnes, equivalent to an annual saving of £2.4 billion worth of food. Targets for improving storage and handling of fresh produce should also be included.

### **Opportunity 11: Government and industry work together on a realistic and sustainable peat-replacement strategy**

Consumers, government and the horticultural industries all want to find a sustainable alternative to peat. Peat harvesting and use contributes substantial carbon release and causes inestimable damage to rare and valuable landscapes and to biodiversity. The availability of growing media needs to be addressed with concerns over availability, cost and suitability for horticultural production. Globally, a 200% increase in peat and 700% increase in coir use is predicted by 2050<sup>60</sup>.

- Establish realistic targets for peat withdrawal from the horticulture supply chain with consideration of available alternatives and potential commercial disadvantages.
- Ensure access to peat alternatives for UK growing media.
- Encourage dialogue with relevant industries as suppliers of peat alternatives, such as wastewater, waste food, and biomass power industries.
- Amend the End of Waste regulations to enable effective use of more organic raw materials
- Identify ways to support growing media manufacturers and growers adapt to peat alternatives.
- Promote collaborative, co-designed research programmes between growers and research providers for the discovery and implementation of peat alternatives.

## Opportunity 12: Collaboration between public and private sector for heat decarbonisation

Protected cropping and controlled environment agriculture (CEA) need to adapt to low carbon energy. Where space is available, solar generation should be encouraged. Joined-up regional planning should couple heat producers with heat users wherever possible. Future heat decarbonisation strategies need to be encouraged by revisions of the planning and regulation system to increase carbon recycling and reduction in heat waste. An example is the Low Carbon Farming project, which could capture 90% of heat requirements from wastewater treatment works. Their facilities, which are two of the largest greenhouses in the UK, could produce an estimated 12% of UK tomatoes with a 75% reduction in carbon footprint. Continued blocking of development risks losing investment in a sector that is already uneconomical to invest in following the loss of the Renewable Heating Incentive.

- Include horticulture in the Business, Energy, and industrial strategy.
- Produce a long-term heat decarbonisation strategy for horticulture.
- Support the planning and development of CEA consortia to co-locate with industrial processing units/energy generators/waste processors to make use of surplus heat and carbon dioxide.
- Support for renewable energy storage facilities for growers is essential to buffer against the volatile energy market.
- Support for longer duration energy storage to balance supply and demand.
- Support annual Contracts for Difference (CFD) auctions on a rolling 3-year horizon for large power projects.
- Ensure best practice is promoted, such as from the GrowSave knowledge exchange programme for horticulture<sup>61</sup>.

## Opportunity 13: Simplify water abstraction and ease regulations for horticultural businesses by:

- Improving dialogue between government, fresh produce growers and water companies.
- Developing national guidelines and incorporating industry water use into the regional water demand prediction models.
- Requiring resource availability and reliability at catchment level.
- Supporting landowners to develop local water infrastructures, such as reservoirs.

**£21 - £105 million benefit in annual carbon savings if net zero is achieved in UK fruit and vegetable production<sup>4</sup>.**

There is an estimated emissions penalty for increasing UK fresh produce production by 30% (Annex 3)<sup>4</sup>. Considering the economic, social and health benefits of realising the NFS, this carbon cost is a small penalty and one which can be remedied with good research. These modest increases could also be offset by modest changes in other sectors of agricultural production.



## 4. RESEARCH AND INNOVATION STRATEGY

Research grants identified through searching the UKRI database with “horticulture” as the keyword amount to £67 million 2006-2021, whilst for “agriculture” the figure is £953 million. That is an approximately 7% allocation to the horticultural sector despite it producing 15% of UK agricultural output<sup>11</sup>. As another indicator, research and development in ornamental horticulture fell by 79% between 1986 and 2015<sup>62</sup>. BBSRC supports 8 Institutes underpinning the agrifood sector, but there are none for horticulture/non-combinable crops.

The AHDB Horticulture levy has served as the only major applied research funder for the fresh produce sector. With the levy ceasing in April 2022, £7.59 million per year of public good research and innovation will be lost to UK PLC. At a time when change is needed, research and innovation are at risk of being lost in the UK. Alternative funding options do not deliver public good research. UK growers need a system which can respond rapidly to emergent threats, before it becomes fragmented and insular, and the fresh produce sector needs a nationally agreed strategy for public good research linked with a capability for best practice knowledge exchange.

The Government Food Strategy<sup>7</sup> stipulates that the government will “spend over £270 million through our Farming Innovation Programme and are supporting £120 million investment in research across the food system in partnership with UK Research and Innovation (UKRI) in addition to other funding packages”. As noted above, whilst funding support for the agriculture and food research is welcomed, the fresh produce sector realises a very small proportion of these totals for reasons outlined above, and for longer term, underpinning science projects the funding model through Innovate UK requires large inputs from businesses winning narrow margins. As such, public good research is waning. A more structured, sector-facing model will help realise the benefits of a thriving, expanding fresh produce sector – as outlined above.

Around £40 million per year has been provided by the government to producer organisations (POs) through the EU Fruit and Vegetable Aid Scheme. Current programmes end in 2024/25 and with the UK now out of the EU, there is significant opportunity to reform the scheme so that it can benefit all growers in the industry.

There exist significant contracts with Defra for facilities in the national interest. There is a case for reviewing the remit and scope of this portfolio as part of the development of a strategy for fresh produce.

### 1.1 Industry representation

Historically, representation of the fresh produce sector has been carried out by the NFU, British Growers Association and AHDB Horticulture. Both the NFU and AHDB also represent the wider agriculture industry, leading to the perception that the larger sectors such as cereals, livestock and dairy take political priority, leaving the fresh produce industry underrepresented.

Horticultural production (along with poultry and pigs) fell outside the scope of the EU CAP, which is recognised in the Fruit and Vegetable Scheme of support for POs. However, the loss of the AHDB Horticulture levy also loses one cross-sector advocate for the sector and the industry is becoming ever more fragmented. The UK fresh produce industry needs a strong, unified voice to represent the industry's best interests and develop a representative vision.

- The Edibles (Fresh Produce) Round Table needs the resources to develop a vision for the sector, with an associated framework for championing best practice, promoting innovation and enhancing environmental stewardship.

### 1.2 Recommendation: Establish a coherent research and innovation funding pipeline

The system needs to become integrated. Government and industry must work together to produce a joined-up R&D pipeline where funding for fundamental discovery, strategic, translational, and applied research is balanced, and work together in a virtuous circle.

- Develop a sector-wide high-level strategic plan for fresh produce crops and systems.
- Co-design a targeted, mission-driven framework to drive and support innovation within a structure of decarbonisation. The sector has a lot to offer towards carbon net zero.
- The co-discovery, co-design model will ensure that innovation is not seen as linear but instead a circular system where results of applied research are fed back into the next cycle of research through the filter of farmer and grower experiences.

- Policies need to be sequenced and costed with the involvement of economists, best practice promoted, and exemplar pathways supported as part of a wider knowledge exchange framework in the sector.
- Initiate a training structure to ensure that the industry has the skills to evaluate and implement new innovation/technology as well as the technical skills to operate it.

### Suggestion: Horticultural Innovation Partnership: Fresh produce innovation centre (FPIC)

Establish a Horticultural Innovation partnership (HIP) that brings together key representatives from across the fresh produce research and innovation community with stakeholder groups. A steering group made up of grower representatives from the industry's POs, from the AgriTech Centres, KTN and with representation from research providers including the academic sector.

The HIP should establish a fresh produce innovation centre (FPIC) to champion collaborative engagement in research, innovation, and knowledge exchange. The FPIC would be a national resource providing strategic direction and horizon scanning, oversee emergency interventions and be guided by its steering group to deliver distinctive as well as pragmatic solutions for the UK fresh produce industries. This centre would contribute long term value for the UK economy and allow the fresh produce industry to achieve a leading global position by:

- Collaborating with TIAH in providing an interactive knowledge exchange hub to enable adoption of new technologies, share expertise and promote best practice across the supply chain.
- Prioritising and delivering challenge-led research with the fresh produce industry.
- Supporting businesses of all sizes in leveraging public and private funding to deliver innovation and improve markets.
- Delivering skilled workers for the sector.

### 1.3 Funding model suggestions

Defra funds resources key to the national interest, such as the various collections of genetic diversity (Gene Banks) and the Genetic Improvement Networks (GINs). Their budgets have all been slimmed down, yet these skeletal infrastructures could be fleshed out to deliver against KPIs necessitated by the government's Food Strategy and Net Zero decarbonisation imperatives. The requirement for continuing expertise and specialist facilities demands that these are longer-term commitments.

#### **Opportunity: Expand scope of key national strategic contracts, such as Gene Banks and Genetic Improvement Networks (GINs)**

- Expand the support for Gene Banks, GINs and similar strategic initiatives to significantly increase exploitation of resources. Introduce performance indicators for exploitation of genetic resources. Extend the remit to include horizon scanning and exploitation, adding further value to curatorship
- Expand best practice for stakeholder-driven KPIs and the co-design of project objectives.
- Successful AHDB-funded projects should be converted to national infrastructure projects with contracts with Defra – e.g. SCEPTREplus on integrated pest management in horticulture and the AHDB Pest Bulletin<sup>63</sup>. These projects are vital for the industry to be able to prevent and tackle pest threats and disease outbreaks which are responsible for yield losses of 20-40% per year globally.
- Provide resources to test/ develop storage and handling facilities.

#### **Suggestion 1: Producer Organisation (PO) funding model\***

Producer Organisations have been funded by EU CAP for their operational programmes to improve their position in the market (£40 million currently given to POs in the UK). POs can allocate 20% of their total operational programme funds to R&D projects, although currently the average is around 2%. Now that we are no longer bound by EU legislation and there is renewed promise from Defra of implementing a new productivity scheme once the current one ends, there is scope to reshape the scheme to fill the innovation gap left by the AHDB Horticulture levy ending.

- Change the contract with POs to commit them to allocate e.g. 20% of their operational programme funding to public good research. This would be a voluntary contribution from growers on the understanding that their investment would be matched under the productivity scheme i.e. £8 million of grower funding (the value of the AHDB levy) plus £8 million matched funding from the new productivity scheme would double R&I at no additional cost to either grower or Government.
- Develop the infrastructure within the residue of AHDB or POs to collect project contributions.
- Develop an infrastructure within POs to manage the R&I portfolio.
- Link to the Edibles Round Table for strategic oversight.
- Review PO coverage and develop a structure for aiding new and SMEs so that everyone benefits from being a PO member.
- Include ornamental growers within this new productivity scheme.

## **Suggestion 2: HortLINK funding model\***

The HortLINK funding scheme was favoured within the fresh produce industry as it addressed key industry issues through pre-competitive applied research with stakeholder involvement at every step. For example, the SCEPTRE programme which provided the groundwork for the more recent SCEPTRE+ programme is an example of a highly successful HortLINK programme.

The Fresh Produce R&I Forum voted this as the most viable funding model to replace the AHDB levy. This model would work by:

1. First the industry must line up and decide upon the overarching long-term R&D priorities (building on Innovate UK's agrifood KTN report "A pre-competitive vision for the UK's Plant and Crop Sector, 2018")<sup>64</sup>. This will give a HortLINK priorities framework.
2. Grower consortia with researchers form around the priority challenges.
3. Consortia apply to the HortLINK scheme for Defra co-funding for programmes that typically last 3-5 years. Strict reporting and knowledge exchange requirements (possibly before final payments) are costed and built into the programme.

\*A SWOT analysis of these two competitive options is given in the Appendices.



## 5. CLOSING STATEMENT

“By moving first, the UK can get ahead of the pack and make the birthplace of the industrial revolution the home of the new Green Industrial Revolution.”

**(Net Zero Strategy: Build Back Greener)**

Our response as a nation to the climate emergency and to the National Food Strategy will define the future for our children. Doing nothing is not an option and already our edible crops are threatened as never before from both new and established pests. Scientific research and innovation is needed more than ever before to tackle these threats and deliver imaginative and sustainable solutions. A sustainable portfolio of strategic support is needed if the UK Fresh Produce sector is to continue to thrive and grow.

**A viable research and innovation programme needs a long-term strategic vision with a plan for necessary and sufficient support.**

# AUTHORSHIP

This draft green paper has been produced by Warwick Crop Centre (Alex Kelly, Prof Richard Napier, Prof Rosemary Collier), with comments and input from Dr Debbie Rees (Natural Resources Unit, University of Greenwich), Lee Abbey (NFU), Dr Amber Wheeler (Fruit and Vegetable Alliance), Rebecca Laughton (LWA), Dr Bill Parker (AHDB), Jack Ward (CEO, British Growers), Tess Howe (TIAH) and members of the Fresh Produce R&I Forum\*. Thijs van Rens and Andrea Guerrieri d'Amati advised/commented on the economic analysis (Department of Economics, University of Warwick).

\*Membership: University of Warwick Crop Centre (Chairs); FERA, NIAB-EMR and NIAB; ADAS Horticulture; Stockbridge Technology Centre; University of Reading; Harper Adams University; Royal Agricultural University; JHI; University of Lincoln and Lincoln Institute for Agri-Food Technology; Cranfield University; University of Greenwich; University of Newcastle; PGRO.

## **Acknowledgements:**

The paper draws on ideas and solutions found in previous reports (e.g. the Ornamental Horticulture Round Table report "Unlocking Green Growth", the report of the UK Horticulture Trade Delegation to New Zealand Horticulture, The National Food Strategy (Dimbleby) and the Government Food Strategy 2022, Decarbonising UK Horticulture production) together with current discussions in the Forum.

# APPENDIX 1: SWOT ANALYSIS

## PO funding model

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Fundamentals of the system are already in place</li> <li>• Matched funding by the EU CAP through the fruit and vegetable aid scheme (would need extending/renewing post-Brexit)</li> <li>• Security of funding over a period of time has been a major benefit of current PO scheme - allowing more strategic approach to investment</li> <li>• PO system is well liked by the industry</li> <li>• Everyone pays, community benefit = public good.</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• Not every grower is in a PO.</li> <li>• The match funding comes from the 'Fruit and vegetable Aid scheme' - Ornamental growers are currently not included in this.</li> <li>• POs not set up as R&amp;I hubs.</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Should be attractive to growers as matched funding would add value to their contributions (only 10% of current Fruit and Veg PO contribution matched by growers would make up for AHDB Hort levy loss of £8 million.</li> <li>• Chance for cross-sector representation and direction under "Round Table"</li> <li>• Widen the definition/ structure of POs so that everyone can benefit from being a member</li> <li>• Include Ornamental growers within the new productivity scheme.</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Complexity of reconfiguring POs to collect payments and organise R&amp;I portfolios</li> <li>• If independent 'AHDB like' board to manage R&amp;D funds is not viable then system could become fragmented as in the Dutch system</li> <li>• Some growers have become disgruntled with POs</li> </ul>

## HortLINK funding model

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Match funding means better 'value' for money.</li> <li>• Previous LINK model was hugely popular across the industry with good knowledge of how it operated.</li> <li>• Results are limited to the people who contributed funds - resulting in a more direct benefit.</li> <li>• No statutory element, therefore, respects the vote.</li> <li>• Strategic priority framework ensures R&amp;D is aligned with stakeholder up and flowing in right direction.</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• Governance required to handle contracts and monitor projects etc - where does this come from?</li> <li>• Potential for businesses not to contribute but still benefit from the information - lack of fairness leading to resentment.</li> <li>• Creates a more segmented industry than a statutory levy.</li> <li>• Those who shout loudest direct strategy for project allocations. Small organisations can't afford to participate/benefit.</li> <li>• Strategy can be hard to flex in times of need.</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Require full payment commitment for duration of programme.</li> <li>• If programme joined late, business is still required to contribute full amount.</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• May not allow the rapid response to emergency threats.</li> </ul>

## Farming Innovate pathway

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Up to 70% of project funded if you are a small business.</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• Weaknesses</li> <li>• Tend to benefit individual businesses.</li> <li>• Do not address on-going common good issues such as crop protection from new and emerging pest threats and disease outbreaks.</li> <li>• Does not facilitate an ability to rapidly respond to new and emerging pest threats and disease outbreaks.</li> <li>• Not centrally organised and therefore lacks a coordinated approach.</li> <li>• Businesses are a greater risk when investing in the scheme compared with the levy as the money isn't nationally pooled.</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Defra needs to produce an overall clear and coherent policy on all of it's schemes and aims with clear details included to enable growers to make crucial long term decisions on investments.</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Risks people going in different directions with regards to innovation with what is limited public money.</li> </ul>

# REFERENCES

## Lead pages and Executive Summary

1. National Food Strategy: Independent Review. 2021. Dimbleby
2. Horticulture Statistics 2021, Defra. <https://www.gov.uk/government/statistics/latest-horticulture-statistics>  
Permanent employment figure. British Growers Association (2022). Accessed: 17/02/2022. <https://britishgrowers.org>
3. See Annex 1
4. See Annex 3
5. Horticulture Business Survey 2022, Defra. <https://www.gov.uk/government/statistics/horticulture-business-survey/horticulture-business-survey-2022>  
Labour in Horticulture Survey. (2021). Results from the Labour in Horticulture Survey 2021 Quarter 3 for England. Defra, Available at: <https://www.gov.uk/government/statistics/results-from-the-labour-in-horticulture-survey-2021-for-england/results-from-the-labour-in-horticulture-survey-2021-quarter-3-for-england>. Accessed 10 Mar. 2022.
6. Levelling up the United Kingdom. 2022. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1095544/Executive\\_Summary.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1095544/Executive_Summary.pdf)
7. Government Food Strategy, 2022. <https://www.gov.uk/government/publications/government-food-strategy>  
The Agriculture Act 2020; The Environment Act 2021.
8. Decarbonising UK Horticultural Production. 2022. Matthew Appleby, Royal Agricultural Society of England. Haymarket publishing.  
Agri- climate report 2021, <https://www.gov.uk/government/statistics/agri-climate-report-2021/agri-climate-report-2021>  
UK Environmental Accounts: 2022, ONS June 2022  
<https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2022>
9. Garnett, T. (2006) Fruit and vegetables & uk greenhouse gas emissions: exploring the relationship. [https://tabledebates.org/sites/default/files/2020-10/fruitveg\\_paper\\_final\\_0.pdf](https://tabledebates.org/sites/default/files/2020-10/fruitveg_paper_final_0.pdf)
9. <https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2021/chapter-13-overseas-trade>
10. Build back greener, 10 point plan. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/936567/10\\_POINT\\_PLAN\\_BOOKLET.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf)
11. Horticulture Production in England, Farm Business Survey, 2020/21. Richard Crane and Rosie Grever. <https://www.ruralbusinessresearch.co.uk/publications>  
Pye Tait (2020) Edible Horticultural Skills 2020 – A Report for the Agricultural and Horticultural Development Board.
12. Land Workers Alliance (2022). Accessed: 03/11/2022. <https://landworkersalliance.org.uk/new-deal-for-horticulture-2>  
Wheeler (2020). COVID-19 UK Veg Box Report. <https://foodfoundation.org.uk/publication/covid-19-uk-veg-box-scheme-report>
13. The Government Food Strategy. <https://www.gov.uk/government/publications/government-food-strategy/government-food-strategy>
14. Hex N, Bartlett C, Wright D, Taylor M, Varley D. (2012) Estimating the current and future costs of Type 1 and Type 2 diabetes in the UK, including direct health costs and indirect societal and productivity costs. *Diabet Med.* 29: 855-62. doi: 10.1111/j.1464-5491.2012.03698.x. PMID: 22537247.
15. Public Health England (2017). Health matters: obesity and the food environment. Accessed: 11/03/2022. <https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2>
16. Veg Facts, 2021. Food Foundation CIO, [www.foodfoundation.org.uk](http://www.foodfoundation.org.uk)

17. 2020 UK Territorial Greenhouse Gas Emissions. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1051407/2020-final-emissions-statistics-one-page-summary.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1051407/2020-final-emissions-statistics-one-page-summary.pdf)
18. Achieving NET ZERO: farming's 2040 goal. <https://www.nfuonline.com/archive?treeid=137544>
19. Garnett, T. (2006) Fruit and vegetables & UK greenhouse gas emissions: exploring the relationship. [https://tabledebates.org/sites/default/files/2020-10/fruitveg\\_paper\\_final\\_0.pdf](https://tabledebates.org/sites/default/files/2020-10/fruitveg_paper_final_0.pdf)
20. A Green Future: Our 25 Year Plan to Improve the Environment. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/693158/25-year-environment-plan.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf)
21. The Ten Point Plan for a Green Industrial Revolution. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/936567/10\\_POINT\\_PLAN\\_BOOKLET.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf)
22. <https://www.ukri.org/about-us/bbsrc/who-we-are/strategically-funded-institutes>
23. The Planetary Health Diet. <https://eatforum.org/eat-lancet-commission/the-planetary-health-diet-and-you>
31. Björnsdotter, E., Nadzieja, M., Chang, W., Escobar-Herrera, L., Mancinotti, D., Angra, D., Xia, X., Tacke, R., Khazaei, H., Crocoll, C. and Vandenberg, A., 2021. VC1 catalyses a key step in the biosynthesis of vicine in faba bean. *Nature plants*, 7(7), pp.923-931.
- Scharff, L.B., Saltenis, V.L., Jensen, P.E., Baekelandt, A., Burgess, A.J., Burow, M., Ceriotti, A., Cohan, J.P., Geu-Flores, F., Halkier, B.A. and Haslam, R.P., 2022. Prospects to improve the nutritional quality of crops. *Food and Energy Security*, 11(1), p.e327.
32. Meelunie (2022). <https://meelunie.com/products/food-products>
33. Kollia, I.; Stevenson J.; Kollias, S. (2021) AI-Enabled Efficient and Safe Food Supply Chains. *Electronics*, 10: 1223. <https://doi.org/10.3390/electronics10111223>.  
<https://www.foodchain.ac.uk>  
<https://www.openaccessgovernment.org/ai-robotics-uks-supply-chain-crisis/123789>
34. (Velde and Kretz, 2020).ditto
35. Skills for jobs: lifelong learning for opportunity and growth. 2021. <https://www.gov.uk/government/publications/skills-for-jobs-lifelong-learning-for-opportunity-and-growth>
36. A New Deal for Horticulture: <https://landworkersalliance.org.uk/wp-content/uploads/2018/10/hortrenewalprog.pdf>

## References: Section 1, Economic development and levelling up

24. OHRG (2021). Unlocking green growth: A plan from the ornamental horticulture & landscaping industry.
25. [https://projectbluearchive.blob.core.windows.net/media/Default/Research%20Papers/Horticulture/TF%20221\\_GS\\_Final\\_2015.pdf](https://projectbluearchive.blob.core.windows.net/media/Default/Research%20Papers/Horticulture/TF%20221_GS_Final_2015.pdf)
26. <https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#energy-plan-objectives-and-key-measures>
27. Automation in horticulture review (2022) Simon Pearson. <https://www.gov.uk/government/publications/defra-led-review-of-automation-in-horticulture/automation-in-horticulture-review>
28. <https://plantandbean.com>
29. <https://www.2bhealthygb.com>
30. Hodmedods (2022). <https://hodmedods.co.uk/collections/beans/products/whole-fava-beans>

## References: Section 2. The National Food strategy

37. Nutritank. <https://nutritank.com/about>
38. Eatwell: <http://www.welllondon.org.uk/37/eatwell.html>
39. Slapø, H., Schjøll, A., Strømgren, B., Sandaker, I. and Lekhal, S. (2021). Efficiency of In-Store Interventions to Impact Customers to Purchase Healthier Food and Beverage Products in Real-Life Grocery Stores: A Systematic Review and Meta-Analysis. *Foods*, 10(5), p.922. Available at: <https://www.mdpi.com/2304-8158/10/5/922/htm>. Accessed 15 Feb. 2022.
40. Walmsley, R., Jenkinson, D., Saunders, I., Howard, T. and Oyebode, O. (2018). Choice architecture modifies fruit and vegetable purchasing in a university campus grocery store: time series modelling of a natural experiment. *BMC Public Health*, 18(1).

41. <https://foodfoundation.org.uk/initiatives/peas-please>
42. Veg Facts (2021). The Food Foundation. Available at: <https://foodfoundation.org.uk/publication/veg-facts-2021>
43. Alaimo, K., Packnett, E., Miles, R.A. and Kruger, D.J., 2008. Fruit and vegetable intake among urban community gardeners. *Journal of nutrition education and behavior*, 40(2), pp.94-101.
44. Barnidge, E.K., Hipp, P.R., Estlund, A., Duggan, K., Barnhart, K.J. and Brownson, R.C., 2013. Association between community garden participation and fruit and vegetable consumption in rural Missouri. *International Journal of Behavioral Nutrition and Physical Activity*, 10(1), pp.1-8.
45. Goulson, D., 2019. *The Garden Jungle: Or Gardening to Save the Planet*. Random House.
46. <https://www.gov.uk/government/statistics/agri-climate-report-2021/agri-climate-report-2021>
47. Garnett, T. (2006) Fruit and vegetables & uk greenhouse gas emissions: exploring the relationship. [https://tabledebates.org/sites/default/files/2020-10/fruitveg\\_paper\\_final\\_0.pdf](https://tabledebates.org/sites/default/files/2020-10/fruitveg_paper_final_0.pdf)
48. Benchmarking greenhouse gas emissions for the UK arable and horticultural sector. Supporting the journey to net zero... [https://chap-solutions.co.uk/wp-content/uploads/2022/08/CHAP\\_Net\\_Zero\\_Report\\_0822.pdf](https://chap-solutions.co.uk/wp-content/uploads/2022/08/CHAP_Net_Zero_Report_0822.pdf)
49. Land use: Policies for a Net Zero UK. 2020. <https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk>
50. <https://www.gov.uk/government/publications/environmental-land-management-schemes-overview>
51. Annex 3
52. AgriFood KTN, (2018). Available: <https://ktn-uk.org/agrifood>
53. Economic Impact of Plant Breeding in the UK. 2010. British Society of Plant Breeders.
54. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/552498/Plant-breeders.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/552498/Plant-breeders.pdf)
55. Plant biosecurity strategy for Great Britain (2023 to 2028). <https://www.gov.uk/government/publications/plant-biosecurity-strategy-for-great-britain-2023-to-2028/plant-biosecurity-strategy-for-great-britain-2023-to-2028>
56. Benchmarking greenhouse gas emissions for the UK arable and horticultural sector. Supporting the journey to net zero... [https://chap-solutions.co.uk/wp-content/uploads/2022/08/CHAP\\_Net\\_Zero\\_Report\\_0822.pdf](https://chap-solutions.co.uk/wp-content/uploads/2022/08/CHAP_Net_Zero_Report_0822.pdf)
57. Land use: Policies for a Net Zero UK. 2020. <https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk>
58. England Trees Action Plan, 2021-2024. <https://www.gov.uk/government/publications/england-trees-action-plan-2021-to-2024>
59. The Courtauld Commitment 2030. <https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment>
60. Blok, 2018. Reflections on the world's need for growing media for food and quality of life in the period 2020-2050. <https://peatlands.org/assets/uploads/2020/05/block.rotterdam.2018.pdf>
61. AHDB Growsave platform. <https://archive.ahdb.org.uk/GrowSave/Horticulture>

### References: Section 3. Environment

46. Agri-climate report 2021. <https://www.gov.uk/government/statistics/agri-climate-report-2021/agri-climate-report-2021>
47. Garnett, T. (2006) Fruit and vegetables & uk greenhouse gas emissions: exploring the relationship. [https://tabledebates.org/sites/default/files/2020-10/fruitveg\\_paper\\_final\\_0.pdf](https://tabledebates.org/sites/default/files/2020-10/fruitveg_paper_final_0.pdf)
48. Benchmarking greenhouse gas emissions for the UK arable and horticultural sector. Supporting the journey to net zero... [https://chap-solutions.co.uk/wp-content/uploads/2022/08/CHAP\\_Net\\_Zero\\_Report\\_0822.pdf](https://chap-solutions.co.uk/wp-content/uploads/2022/08/CHAP_Net_Zero_Report_0822.pdf)
49. Land use: Policies for a Net Zero UK. 2020. <https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk>
50. <https://www.gov.uk/government/publications/environmental-land-management-schemes-overview>
51. Annex 3
52. AgriFood KTN, (2018). Available: <https://ktn-uk.org/agrifood>
53. Economic Impact of Plant Breeding in the UK. 2010. British Society of Plant Breeders.
54. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/552498/Plant-breeders.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/552498/Plant-breeders.pdf)
55. Plant biosecurity strategy for Great Britain (2023 to 2028). <https://www.gov.uk/government/publications/plant-biosecurity-strategy-for-great-britain-2023-to-2028/plant-biosecurity-strategy-for-great-britain-2023-to-2028>

### References: Research and Innovation Strategy

62. Hess, T. and Sutcliffe, C. (2018). The exposure of a fresh fruit and vegetable supply chain to global water-related risks. *Water International*, 43(6), pp.746-761.
63. <https://horticulture.ahdb.org.uk/SCEPTREplus>
64. <https://ktn-uk.org/news/a-pre-competitive-vision-for-the-uk-plant-and-crop-sector>

## Annex 1: Economic calculations for GDP and employment (Van Rens and Guerrieri D'Amati)

### GDP contributions:

This annex shows the calculations used to understand and replicate the GDP contributions and monetary value of changes in emissions in the green paper "Growing British - a strategy paper for promoting fresh produce production in the UK". We estimated how much GDP, and employment would increase if we were to implement the National Food Strategy (Dimbleby) recommendation to increase fruit and vegetable (F&V) consumption by 30% by 2032.

We used the following calculation:

$C$  = current (2020) consumption of F&V in the UK, calculated as F&V produced in the UK ( $Y$  for future reference) + imports of F&V - exports of F&V (all in £) = £9.5bn

$$\Delta C = 0.3 * C$$

Some of  $\Delta C$  will be imported because it consists of F&V that cannot be or are not produced in the UK, therefore

$$\Delta Y = \lambda * \Delta C$$

where  $\lambda$  is either 0.5 (based on the assumption that 50% of F&V consumed can be produced domestically, which is the assumption you made in the draft) or the actual fraction of F&V currently consumed that is currently domestically produced, i.e.  $\lambda = Y / C = 0.35$ . This gives us two values of  $\lambda$ :  $\lambda_1 = 0.5$ ,  $\lambda_2 = 0.35$ .

Finally, to get at the contribution to GDP, we need to correct for the fact that production requires inputs (fertilizer, pesticides, etc.), so that output does not equal value added (which is what GDP is composed of) of a sector.

$$\Delta GDP = \mu * \Delta Y$$

where  $\mu$  is the fraction of output that is value added, which we calculate as output minus costs over output, and costs are a share of costs that are directly associated with horticulture (seeds, fertilizer, plant protection products) proportional to the share of F&V in horticulture, and a share of fixed costs, proportional to the share of F&V in total agriculture (crops plus livestock) to find  $\mu = 0.52$

We also split the GDP contribution numbers up in veg and fruit, and find that fruit contributes £313mn and veg £207mn, due to the fact that consumption of fruit is a bit higher, but the import share is higher as well, whereas intermediate inputs are lower for fruit. Table 1 shows the results of these calculations. One can see that an increase in the production and consumption of F&V would contribute between £520mn and £746mn depending on the  $\lambda$  chosen.

**Table 1: Estimation of contributions to GDP**

	F&V( $\lambda_1$ )	F&V( $\lambda_2$ )
C	£9.5bn	£9.5
$\Delta C$	£2.8bn	£2.8bn
$\Delta Y$	£1.4bn	£990mn
$\mu$	0.52	0.52
$\Delta GDP$	£746mn	£520mn

Notes:  $\lambda$  refers to the fraction of products that can be produced domestically, assumed to be either 50% or the actual fraction of products currently consumed that is produced domestically.  $\mu$  refers to the fraction of output that is value added, calculated as output minus costs over output, with costs computed as the share of costs that are directly associated with each sector proportional to the share of the product in the specific sector.

## Employment:

The effects on employment are calculated on the basis of a proportional rise in jobs with the rise in UK production by taking into account the share of workers employed in a specific sector relative to the agricultural sector (i.e., horticulture in agriculture). Given that disaggregated data on horticulture employment is not available after 2019, and the one that exists is only available for England, we approximate the number of workers employed by taking the fraction of people working in horticulture in England in 2019 (assuming this being relatively constant over time) and then multiplying this fraction by the total amount of workers employed in agriculture in the UK in 2021.

In mathematical terms:

$$\Delta N_i = \Delta Y / Y * N_{\text{hort}}$$

$N_i$  is the number of workers employed in horticulture relative to the total recorded workers in the agricultural sector in England ( $N_{\text{agr}}$ ). That is:

$$N_{\text{hor}} = N_{\text{hor,EN,2019}} / N_{\text{agr,EN,2019}} * N_{\text{agr,UK,2021}}$$

Given the presence of  $\Delta Y$ , the final value will depend on the value of  $\lambda$  calculated in the previous section (i.e.,  $\lambda_1=0.5$  or  $\lambda_2 = Y / C = 0.35$ ). Table 1 shows the value of the estimation.

**Table 2: Estimation of contribution to employment**

	F&V( $\lambda_1$ )	F&V( $\lambda_2$ )
C	£9.5bn	£9.5
$\Delta C$	£2.8bn	£2.8bn
$\Delta Y$	£1.4bn	£990mn
$\mu$	0.52	0.52
$\Delta \text{GDP}$	£746mn	£520mn

Notes: N refers to the fraction of workers employed in horticulture relative to the agricultural sector in England. Contribution is calculated as number of jobs created.

## Annex 2: Economic calculations on emissions (Van Rens and Guerrieri D'Amati)

To calculate the effect of increasing F&V consumption by 30%, we first had to match the available data on home production, imports, exports, and emissions. After matching the variables, we need to calculate total emissions by category (i.e., F&V):

- Vegetables: Beans, Cabbages, Lettuce, Onions, Leeks, Other Fruit, Other Vegetables, Peas, Root Vegetables, Tomatoes
- Fruits: Berries, Grapes, Cherries, Strawberries, Apples and Pears, Plums, Raspberries, Other fruit

Once the data was matched, we calculated the environmental impact of consumption of different products.

Calculating the reduction in emissions is done by multiplying the emission data for each product by their reduction in consumption, or more formally:

$$\text{TEM}_i = (-0.3) * (C_i * \text{EM}_i)$$

where  $i \in \{F, V\}$ ,  $\text{TEM}_i$  is the total emissions, and  $\text{EM}_i$  is the emissions per item. The net change in emissions is an increase by 1.3 million tonnes of CO<sub>2</sub>, calculated by first computing the change in emissions attributable to changes in consumption of fruits and vegetables. Then, using the estimated \$51/ton social cost of carbon from IWG (2013), the net effects of a 30% rise in home grown F&V production translate into approximately \$60 million dollars cost for the British economy.

**Table 3. Estimation of added emissions**

	Fruit	Vegetables	Total
Emissions (million tons)	0.431	0.876	1.307
Emissions (billion \$)	0.02	0.04	0.06

### **Annex 3: Net zero social cost of carbon calculations (Kelly, Collier and Napier)**

This annex shows the calculations used to understand and replicate the net zero social costs of carbon savings figures in the green paper "Growing British - a strategy paper for promoting fresh produce production in the UK". We estimated the monetary gains in terms of the social cost of carbon (SCC) for achieving net zero emissions in fresh produce production in line with the NFU's net zero 2040 goals. We have also estimated the value of net zero for the entire fresh produce supply chain.

To work out an estimated SCC saving for achieving net zero in both fresh produce production in the UK and the fresh produce supply chain we used the following calculation:

Industry contribution to total UK GHG emissions (carbon contribution of fresh produce production [%] or carbon contribution of the fresh produce supply chain [%]) \* Total UK annual GHG emissions \* SCC.

Fresh produce production total UK GHG contribution = 0.1-0.2%6.

Fresh produce supply chain total UK GHG contribution = 2.5%7.

SCC = \$515. Total UK annual GHG emissions (2021) = 478 Mt Co2e6.

Current USD to GBP = 0.87 (31/10/2022).

Lower estimate, fresh produce production annual savings:  $0.001 * 478\text{Mt Co2e} * \$51 = \$24.37\text{mn} = \text{£}21.24\text{mn}$ .

Upper estimate, fresh produce production annual savings:  $0.002 * 478\text{Mt Co2e} * \$51 = \$24.37\text{mn} = \text{£}42.48\text{mn}$ .

Fresh produce supply chain annual savings:  $0.025 * 478 * \$51 = \$609.45\text{mn} = \text{£}531.14\text{mn}$

We then repeated these calculations using a newer proposed SCC figure from the climate impact lab of \$1257:

Lower estimate, fresh produce production annual savings:  $0.001 * 478\text{Mt Co2e} * \$125 = \$59.75\text{mn} = \text{£}52.52\text{mn}$

Upper estimate, fresh produce production annual savings:  $0.002 * 478\text{Mt Co2e} * \$125 = \$119.5\text{mn} = \text{£}105.3\text{mn}$

Fresh produce supply chain annual savings:  $0.025 * 478 * \$125 = \$1.49\text{bn} = \text{£}1.3\text{bn}$

### Data sources:

The data used in annex 1 was taken from National statistics<sup>1</sup>, the June Survey of Agriculture<sup>2</sup>, from Clune et al (2017)<sup>3</sup>, Poore and Nemecek (2018)<sup>4</sup> and from IWG (2013)<sup>5</sup> for agricultural production and consumption, employment data and emissions data respectively.

- <sup>1</sup> Available at: <https://www.gov.uk/government/statistics/latest-horticulture-statistics> (2021)
- <sup>2</sup> Available at: <https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june> (2021)
- <sup>3</sup> Clune, S., Crossin, E. and Verghese, K. (2017), 'Systematic review of greenhouse gas emissions for different fresh food categories', *Journal of Cleaner Production* 140, 766–783.
- <sup>4</sup> Poore, J. and Nemecek, T. (2018), 'Reducing food's environmental impacts through producers and consumers', *Science* 360: 987–992.
- <sup>5</sup> IWG (2013), 'Technical support document:- technical update of the social cost of carbon for regulatory impact analysis-under executive order 12866'. [https://www.epa.gov/sites/default/files/2016-12/documents/sc\\_co2\\_tsd\\_august\\_2016.pdf](https://www.epa.gov/sites/default/files/2016-12/documents/sc_co2_tsd_august_2016.pdf)

The data used in annex 2 was taken from ONS (2022)<sup>6</sup>, Garnett, T. (2006)<sup>7</sup>, and from Carleton and Greenstone (2021)<sup>8</sup> for net zero SCC estimations.

- <sup>6</sup> Available at: <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/ukenvironmentalaccounts/2022#greenhouse-gas-emissions> (2022).
- <sup>7</sup> Garnett, T. (2006) Fruit and vegetables & uk greenhouse gas emissions: exploring the relationship. [https://tabledebates.org/sites/default/files/2020-10/fruitveg\\_paper\\_final\\_0.pdf](https://tabledebates.org/sites/default/files/2020-10/fruitveg_paper_final_0.pdf)
- <sup>8</sup> Carleton, T. and Greenstone, M. (2021). Updating the United States Government's Social Cost of Carbon. *SSRN Electronic Journal*.



**To find out more please contact**

**Professor Richard Napier**

Deputy Head of the School of Life Sciences (Operations)

**Email:** [Richard.Napier@warwick.ac.uk](mailto:Richard.Napier@warwick.ac.uk)

**Phone:** +44 (0)24 765 75094