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W H I T E P A P E R —
S H O U L D C I T I E S
A I M T O B E S E L F -
S U F F I C I E N T I N
F O O D P R O D U C T I O N ?

 Rize^{etf}

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Background

*Urban farming has grown across many cities in the UK with the potential to provide a variety of benefits to promote food security, address social, environmental and economic concerns, as well as encourage local food production, nutrient recycling, urban green space, and biodiversity. Urban agriculture (UA) is defined as the farming practice of growing plants, fungi, fish and livestock in and around towns and cities.*⁵²

84% of the United Kingdom (UK) population live in urban areas.^{1, 2} Population growth and urbanisation is only set to increase, with predictions showing that the UK population could reach over 74 million people by 2050,³ increasing the demands for food supply. This raises significant challenges on urban resilience, notably the issue of self-sufficiency and sustainable food security within urban areas.³³ The increase in food demand caused by population growth not only places additional pressure on resources to produce food, contributing to the effects of climate change, but also increases the competition for land use, as developments encroach on the limited greenspace within cities and their suburbs.⁴

Today, 17% of the UK population live in rural settings.³⁷ The combination of increased urban migration, and the resultant fall in knowledge transfer of traditional agricultural skills will only exacerbate these knock-on effects to food security.

With the recent disruption to food supply chains brought on by COVID-19, Brexit and the ongoing conflict in the Ukraine, questions have been raised about the reliance the UK places on the 'global larder' and imports of goods, and whether cities should be aiming to be more self-sufficient when it comes to food.^{60, 82} UA could be a practical and sustainable means to address urban food insecurity in the face of rapid urbanisation, whilst also providing several other benefits to diet, health, livelihood, culture, social equality, climate change and natural resources.⁵

Growing food in cities is not a new concept, with initiatives going back to the Roman ages, allotments and the 'Dig for Victory' campaign during WWII to support the cause. Today there are over 10 million people in the UK living in food retailing deserts and not able to easily access fresh, affordable produce.^{6, 57, 83} Growing food in cities brings fresh produce closer to the consumer at affordable prices, reduces waste, and places less reliance on the supply chain, where 'food miles' contribute meaningfully to GHG emissions.⁵³

Although urban farming and UA is not yet widespread common practice, nor a complete solution for nutrition and food security, it is a novel way to utilise urban space and update agricultural norms to solve our modern global food issues.⁷

In this white paper, we discuss Urban Agriculture and the possible scale of production. We consider types of land that could be used for the production of crop, competing land use within cities, and novel farming techniques such as vertical food farms, green walls, hydroponics, underground farms and rooftop agriculture.



Urban agriculture benefits and growing food in cities

Food is an essential component to our lives. It is not only a source of nourishment, but also enjoyment. With the majority of the UK population living in cities today, and in the context of increasingly extreme weather patterns and disruptive events such as Brexit, the recent COVID-19 pandemic, and the ongoing conflict in the Ukraine that increase the threat of food insecurity, growing food in cities and urban spaces is an important innovation and move towards a more resilient and circular economy.

There is a need to increase our awareness about our food systems – making the invisible visible – to dissipate the growing disconnect of urban consumers who buy food without context or knowledge of its origin. There is an increased desire to connect ‘urban’ and ‘food’ with one another.

UA can also contribute significantly to improving the quality and sustainability of life for those living in urban areas.⁴²



Environmental

Cities are open ecosystems. UA has the potential to benefit the environment by reducing the negative effects of transport mileage.²⁰ This is particularly true of imported out-of-season high value, high perishable foods such as berries, salads, and leafy greens.²¹ UA also contributes to habitats for pollinators,²² helps to reduce the effects of urban heat islands²³ and encourages the recycling of wastewater and nutrients.⁵

Social

UA, communal allotments and gardens in cities have contributed significantly to creating communities, reconnecting neighbourhoods through developing a stronger bond to land, and increasing awareness of the importance of nature to citizens' health and well-being perspective.^{17, 19} For as many as 40% of the population, urban green spaces within cities are citizen's only access to nature and the environment.³² UA can forge stronger connections between farmers and consumers,⁵ improving the aesthetics and liveability of urban areas, and provide an educational platform for all.²⁴⁻²⁶ UA could positively influence diet, providing greater accessibility (both in terms of proximity and cost) to fresh and healthy produce to citizens. The knock-on effect of adopting more plant-based diets can help reduce disease risk and therefore alleviate this pressure on the UK's NHS.^{5, 27, 28} There is also evidence to suggest the psychological benefits of UA.^{29, 42}

Economic

Widespread UA across the UK could inspire and generate employment in the farming, food and green industry, also making it more accessible for those living in cities to choose this as a career option.³⁰ Growing food in cities can also encourage the growth of urban tourism and local economies. As mentioned above, new methods and technology for UA also offer accessibility to food for low-income families, therefore providing food security.^{5, 6, 31}



Terminology and types of novel UA practices

Vertical food farms: where crops are grown vertically, stacked one on top of the other, using Controlled Environment Agriculture (CEA) technologies – predictable, stable, controlled and sustainable environments to grow foods.

Rooftop agriculture: where crops and produce are grown capitalising space flat roofs of buildings have to offer

Hydroponics: a scientific method of growing plants (best for salads, leafy greens or vegetable plants) without the use of soil. The plants are grown in mineral rich water which can be recycled, with only small amounts needed. Used widely in vertical food farms as it is a technology that is accessible and not bulky

Aquaponics: this farming method utilises the waste of one element to benefit another to recreate a natural ecosystem. It represents the integration between water, aquatic life, bacteria, nutrients and plants in a water system. Typically used to farm fish but also plants.

Green walls: another type of vertical farming where plants and vegetation are planted using soil and an irrigation system

Underground farms: underground growing of food using Controlled Environment Agriculture (CEA) technologies – predictable, stable, controlled and sustainable environments to grow foods. Spaces used could be abandoned mines or tunnels.

Current context

Our current food system is ineffective and linear, where for many, much of it is wasteful, polluting, inaccessible/ unaffordable and unhealthy. The annual societal impact to the UK from hidden food system costs is estimated at £116.33 billion.⁸ The majority of this cost comes from natural capital degradation (GHG emissions, air pollution, food & packaging waste, water consumption and soil pollution), but also social and health related cost.⁸

The UK farming industry uses 71% of the country's land mass,⁹ but only employs 1% of the population.¹⁰ That said, agriculture and farming feed into the food industry that as a whole, employs many more people and contributes 9.4% to national Gross Value Added (GVA).¹¹

Horticulture production in the UK has seen a significant decline by over 27% in the last 25 years, and it occupies less than 4% of total arable land in the UK.⁹ The production of horticulture contributes £3.2 billion to the economy annually and employs 50,000 full-time workers.^{62, 84} A challenge is that typically, jobs found within the food industry (horticulture, manufacturing, retail, catering, distribution, farming, etc...) are labour intensive, poorly paid and associated

as low status. Only 3% of farmers in the UK are under the age of 35, with most over the age of 65 and this is only increasing.^{62, 84} There is a necessity to reinvigorate and incentivise people to work within the food and agricultural sector which would help reduce unemployment, boost economic growth and could provide locally grown fresh produce through greater use of UA.^{12, 61-63}

The UK's level of self-sufficiency today is much lower than it was 30 years ago, with 45% of foods consumed in the UK being imported from abroad.¹³ 84% of our fruit and 47.3% of our vegetable come from abroad contributing to an almost £10bn trade deficit in fruit and veg compared to other food categories in the UK.¹⁴

The potential to grow, harvest and distribute more foods, particularly fruit and veg that can be grown in cities all year round would significantly help the UK and urban areas become self-sufficient, as well as protect rural land mass, blue space, and protect against biosecurity issues.

Limitations and challenges

The benefits of UA in the UK are dependent on the context of a city and due consideration is required of the climatic, environmental and spatial constraints such as urban planning, water and land use. It is suggested that a city requires up to 200-300 times more land mass than its own footprint to be fully self-sufficient and feed its population, depending on its density.⁵ That said, there are a number of positive case studies across the UK to suggest that these constraints can be overcome.

Social and public health

Cases of food insecurity and lost nutritious produce caused by labour disruption and logistics challenges (smashed eggs, milk rivers, rotting crop in fields) following the outbreak of COVID-19 have been well documented.^{44, 45} Therefore, producing local produce strategically reinforces social security and public health. From a public health perspective, it is unrealistic to suggest urban populations live off a plant-based diet that is produced solely within their city. However, the reality is that UA is already

producing many food types (fruit, vegetables, eggs, honey and poultry). The issue is that the foods tend to be high perishable, high value products that have a low calorific output.⁴⁶ Food does not equal nutrition, and it's important to understand each city and its regional nutritional context, its values and demands, in order to supply its citizens with sufficient daily calories.^{43, 57} Ultimately, a balance is needed so that we are not reliant on any one system to provide food for our nation.

Consumer demand

Over the last twenty years, changing consumer habits have driven the decline of self-sufficiency in food production in the UK, as perishable, out of season, fresh foods are expected on our

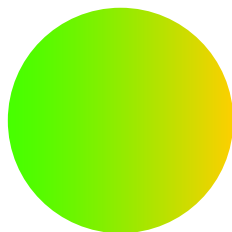
supermarket shelves throughout the year.³⁶ The demand and market for berries, leafy salads in bags and cherry tomatoes for example have each at least doubled in the last decade.⁶⁴

Land use

Competing land use can be a challenge especially when considering the space needed for growing food in greenspace or non-greenspace. Accessing and finding suitable land surrounding cities in the peri-urban or urban fringes is a barrier to entry, as often this space overlaps with protected land under local planning policies or the Green Belt laws.⁶³

Urban population density will be one of the determining factors on which urban farming method is used, i.e. traditional farming in the suburbs, rooftop, vertical, underground, hydroponic or aquaponic.⁵⁰

Looking ahead, urban regeneration will become a driver of land use change. For example, car parks that become disused as we ride share or turn to self-driving cars, or indeed empty shopping malls can be converted for community purposes and growing food. However, land use change is also sensitive to rival economic forces and policy choices as well as being dependent on future uncertainties such as technological and scientific change, energy prices, and policies on tax / subsidy, such as the impact of biofuel production which can compete with food crop.



Water use

Water use has exponentially increased as a result of population growth. The intensive use of water in the process of agriculture is widely known and has been a concern when it comes to UA. However, through the employment of small-scale irrigation,

hydroponics, aquaponics and other intensive UA innovations, growing food on rooftops, vertical infrastructures and underground farming methods have been developed to overcome many of these constraints.⁵¹

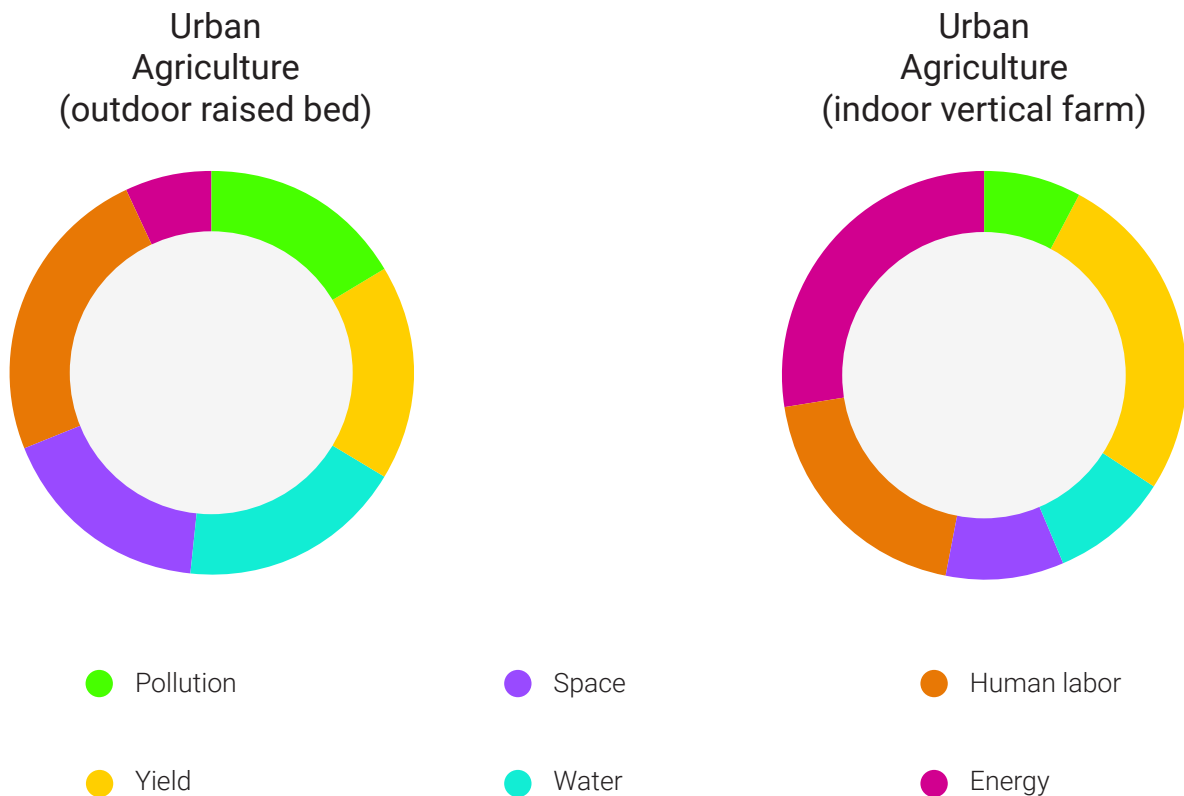
Data and supporting research

In contrast to more traditional farming methods in rural areas, the advances of science and technology can contribute to higher yields, as well as efficient and sustainable systems that support more resilient futures.⁴⁷⁻⁴⁹ However, as these are new technologies, as of today there is a lack of data to support certain assumptions,⁵⁰ and there remain several unknowns with respect to the medium- to long-term impacts of these technologies. Greater

funding and research in the different methods of UA could lead to considerable improvements in this sector.

Likewise, although UA can reduce transport mileage and the associated emissions,³⁴ the significant energy required to produce foods locally may contribute to higher overall emissions³⁵ as illustrated in the below Figure 1.

Figure 1: A comparison of scale of input (Energy, Human Labour, Water, Space) vs output (Yield, Pollution) from outdoor and indoor UA.⁵



Policy and regulation

With greater acceptance that food production in rural lands is no longer the authority of productive farming, many are considering production within cities, exploring types of foods that can be grown, techniques for growing it, and the potential yield that could be expected. This is exemplified by the number of grants and subsidies being phased out by the government due to the number of ineffective farms across the UK.³⁸ This puts into question the future of rural agriculture, paving the way for UA and freeing up land for climate and biodiversity initiatives outside cities.³⁹

With the view to protecting the natural assets that are key to food production in the UK, the Environmental Land Management (ELM) scheme has set out clear goals on boosting sustainable food production in the UK through land management plans, spatial prioritisation, collaboration with environmental and agricultural stakeholders.⁵⁵ The policies the ELM and the Agricultural Bill are outlining incentivise food growers to invest in sustainable technologies that increase productivity without damaging the environment, support innovation within agriculture, and prioritise a fairer supply chain. Soil degradation (loss of nutrients, compaction, erosion) from poor and intensive farming is estimated to have cost the UK £1.2 billion.^{54, 85}

The use of land use regulation, zoning, permits and bans for effectively managing land activity in the UK are powerful methods for guiding businesses. Through the use of zoning within cities and urban areas, agricultural and natural land can be protected or preserved for the purpose of food growing in local areas and communities. Zoning and permits can encourage UA which will in turn support the social, economic and environmental needs of a city. If used correctly, such methods can also prevent unsustainable agricultural land use and non-agricultural land use.^{40, 41} It has been identified that the types of non-agricultural land best suited to UA could be rooftops, underground tunnels, shipping containers, vacant industrial plots, disused warehouses and even the potential for floating farms.⁵²

Why change now? What about the past initiatives?

There is a long history of urban food growing with a number of small-scale urban food productions examples such as the Tower Hill market garden in London¹⁵ dating back to the Tudor era.

Allotment gardening is also a long-standing urban institution and campaigns such as 'Dig for Victory' promoted at the start of WWII, were critical to the survival of the UK at the time.^{18, 62} Community style gardening is becoming increasingly popular and has seemingly lost its stigma from war times.

The rise in ecological awareness during the 1970's and 1990's, coupled with higher food prices and disused land (a result from high land prices at the time), led to great interest in cities and their people becoming self-sufficient in the UK.^{12, 16}

2 ZERO HUNGER



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



17 PARTNERSHIPS FOR THE GOALS



Not only has growing one's own food become trendy again, but it has also become a form of education in schools and empowers people to be part of a more sustainable system and contributes to the global Sustainable Development Goals, particularly goals 2 (zero hunger), 12 (responsible consumption & production, 15 (life on land) and 17 (partnerships for the goals).⁵⁶

The combined forces of growing urban populations and the evolution of cities have prompted agricultural advances. Cities have always been closely interlinked with rural areas because of their dependence on food but with today's technological advances, growing food in cities need not rely solely on traditional farming practices that require large amounts of land.⁷⁵⁻⁷⁷



Recommendations and actions for the future

The aim of UA is to achieve food security, improve nutrition and promote sustainable agriculture through building a resilient system which is at the heart of sustainable development. Cities have the power to influence how food is grown as well as benefiting the economy, health and well-being of its population, and the environment.⁴²

It is perhaps unrealistic to suggest that all cities in the UK can be fully self-sufficient given our reliance on non-domestic foods and taking into consideration the foods required for a balanced and healthy diet. However, Brexit, the COVID-19 pandemic and the conflict in the Ukraine have highlighted the fragility of our food system, particularly the fragility of the global supply chain and our reliance on it.^{43, 87} Food tariffs are increasing on imports, resulting in higher food prices and greater food insecurity.^{86, 87} As we have seen in recent weeks, food prices are very sensitive to geopolitical shocks and global markets. By creating local UA where citizens and cities are encouraged to grow their own food or source high value, high perishable foods locally, this could solve many issues.

For successful UA integration within cities there is a need to be creative with land use and repurpose derelict industrial sites, abandoned buildings and vacant rooftops. If food was grown closer to where we consume it, this could reduce transport time and associated emissions, resulting in an increased shelf-life for produce in supermarkets, and the consumer would be eating fresher produce. UA is also a means to provide education on agriculture and food to children in schools, as well as training and employment opportunities for local people.⁶³

There is a need for greater communication and advocacy to educate actors and communities on the initiatives of UA in both horizontal and vertical farming.⁵⁰ Active participation, buy-in, proper management and effective governance from the many key stakeholders such as local authorities and government representatives is required.⁶¹ Additionally, there is a greater need for research and funding for UA and novel food production techniques.

There are a number of successful case studies across the UK that do add value, (supporting local restaurants, hotels, local neighbourhoods and their supermarkets) and there are also many foreign examples to learn from. In the UK, cities such as Bristol, Leeds, Manchester and London are incorporating successful UA practices to support the existing food system infrastructure.⁷⁴

Heavy reliance on imports of fruit and vegetables invites greater risk of biosecurity issues. Therefore, growing food in controlled environments enhances food security, reduces wastage across the supply chain, protects crop from the vulnerabilities of weather extremes and hardships, pests, disease and soil degradation, making the UK and cities more resilient to climate change.

Case studies

Today, **Leeds** local food production system can only produce up to 50% of the city's calorific intake. Eating locally is not an option for everyone as a result and the system is open to disruption, tending to impact the most deprived. Leeds has over **1000 km²** of land (4x the size of Edinburgh city), made up of unused warehouses and buildings, and derelict land that could be used for UA and new technological farming techniques. Leeds also has **100 hectares** of allotment gardens and **49 hectares** of private gardens. There are over **5,500 businesses** supplying fresh food daily. Leeds has a significant amount of underused space that could be repurposed into a no waste, resource efficient urban food ecosystem through the use of a number of UA technological methods, both traditional and novel.^{58, 59}

Already, many people living in **London** grow their own foods though allotments, private gardens, projects such as Energy Garden⁶⁶ that combine horticulture and renewable energy have been created, schools are participating in initiatives such as Learning Through Landscapes⁶⁹ and Grow2Know,⁶⁷ and food projects such as the Felix Project⁶⁸ have come about in response to COVID-19 to support those most in need. It is estimated that 47% of land in London is made up of vegetated green space.⁷³ London has the potential to grow a yearly average of around 232,000 tonnes of fruit and vegetables which would on average supply Londoners with 18% of their daily nutritional intake and account for one of the recommended 5 a day portions of fruit and veg.^{12, 41, 65}

Exciting new initiatives are being created in disused and underground land across London using hydroponic and vertical farming methods such as Harvest London based in Leyton. This business is growing specialty foods for chefs and other partners within the food industry. Their produce

travels less than 5 miles direct from their farm enabling **traceability**, it is all **sustainably grown** with reduced energy consumption, less water usage, **no pesticides** used and because of the controlled environment in which it is grown, there is **year-round** harvest available to keep up with demand.⁷⁰ **Clapham** has an underground farm 33 metres below ground, housed in an old air raid shelter. Using ultra-accurate LED lighting and hydroponics, Growing Underground started in 2015 and is now supplying fresh micro herbs, leafy salads and greens to major supermarkets, restaurants and local consumers all around London in a bid to revolutionise the UK's agricultural system. Growing Underground pioneered CEA in the UK, combatting against biosecurity issues and pollution too.^{71, 72}

Making all cities across the UK completely self-sufficient through UA is probably unrealistic, but cities such as Bristol and Manchester are using food growing as a holistic solution to reconnect their citizens with nature, bring together communities, raise awareness on critical environmental issues and the benefits of local food systems eg: Grow Bristol and Lettus Grow or CEA grown mushrooms in Manchester.⁷⁴ Being self-sufficient in certain crops or produce is definitely achievable with vertical farming, hydroponics, underground, rooftop or container farming playing a key role in moving toward a more sustainable urban existence and providing good food for all.

Conclusion

Climate change, weather extremes and increased urbanisation due to population growth are putting significant pressure on our food system and food security, whilst sudden event shocks such as the COVID-19 pandemic, Brexit and the ongoing conflict and war in the Ukraine have highlighted the fragility of our food system.

Urban farmers have a unique opportunity to touch on many disciplines at once and become dynamic forces of positive change in their communities. A number of benefits are derived from Urban Agriculture which is able to address many interconnected environmental, social and economic concerns.

Urban farming has the potential to support the demand for local food in environments where traditional farms cannot thrive. As more restaurants, schools and institutions seek out sources of local food, there is an opportunity for small businesses and food entrepreneurs to explore urban agriculture supporting the local economy. This in turn creates more employment opportunities and strengthens communities. Urban agriculture provides a solution for vacant and under-utilised land scattered throughout cities with projects make efficient use of rooftop space. Community gardens transform spaces and give individuals an opportunity to take stewardship of common land and become more involved in their communities. Urban agriculture increases access to affordable, healthy, fresh produce and provides a unique opportunity for communities to learn about nutrition and how to grow food. Lastly, localised food production has the potential to reduce the environmental impact of agriculture. While there is a need for better transportation infrastructure, food grown locally travels significantly less from the farm to fork, alleviating carbon footprints through eliminating unnecessary food miles. Additionally, urban farmers often adopt more environmentally-friendly growing practices, using fewer pesticides and chemical fertilizers.

There are however considerations for growing food in cities, of which access to water, land use, and soil degradation are key. Policy and engagement challenges also remain from the government, local authorities and community buy-in.

Whilst it is unrealistic for all cities in the UK to become fully self-sufficient when it comes to food, Urban Agriculture could significantly help alleviate pressures in rural areas on our food system generally, as well as reduce emissions, provide jobs and provide a form of education.



Related ETF

FOOD: The Rize Sustainable Future of Food UCITS ETF seeks to track the Foxberry Tematica Sustainable Future of Food Index. The objective of the Index is to provide exposure to companies that are innovating across the food value chain to build a more sustainable, secure and fair food system for our planet.

Capital at Risk Warning: An investment in the Fund(s) involves risks, including illiquidity, lack of dividends, loss of investment and dilution, and it should be done only as part of a diversified portfolio. The Funds may be registered or otherwise approved for distribution to the public in one or more European jurisdictions. Investors should continue to consider the terms of investment in any Fund (or Share Class thereof) carefully and seek professional investment advice before taking any decision to invest in such Fund (or Share Class thereof).

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