FINAL

Agricultural Technology – Market Review

June 2017

Contents

1 Introduction

1.1 Background

By 2030, UK industry and government have a goal of capturing 10% of the Global Space market, taking UK revenues to £40bn with 100,000 jobs created. The 2010 Space Innovation and Growth Strategy (IGS) developed the subsequent Space Growth Action Plan which identified 15 priority markets that rely on space and have significant growth potential. Each of these priority markets was thought to be able to deliver £1bn in revenue to the UK by 2030. Agricultural Technologies (Agri-Tech) was identified as one of these priority markets. To this end, the government set out a vision for the industry in the 2013 'UK Strategy for Agricultural Technologies':

'That the UK becomes a world leader in agricultural technology, innovation and sustainability; exploits opportunities to develop and adopt new and existing technologies, products and services to increase productivity; and thereby contributes to global food security'.

This report provides an overview of the current market for agri-tech and assesses the opportunities for UK companies. It is based upon freely available data from literature reviews, workshops and reports carried out by the Satellite Applications Catapult (referred to as "Catapult" henceforth) and interviews with industry contacts. In this way, this report presents the collective view of key stakeholders in the agri-tech sector.

1.2 Market definition

This report will cover the use of satellite technologies to aid the sustainable intensification and food security in arable and livestock farming. These technologies will be referred to as satellite-enabled agricultural technologies (agri-tech). The use of agri-tech in horticulture, silviculture (forestry) and aquaculture is not within the scope of this report. Similarly, it will not cover internet coverage in rural areas as this is already covered in the IGS Fixed Satellite Broadband Report.

The specific technologies considered in this report are **Global Navigation Satellite System** (GNSS), **Earth Observation** (EO) and **Satellite Communications** (Satcoms). **Unmanned Aerial Vehicles** (UAVs) can be used to augment and complement satellite technologies and are considered in this report in recognition of their potential for agricultural applications[1] even though their current uptake is limited by a number of factors, including regulation and technical barriers (e.g. range). In many cases, these technologies are used in combination to enable a range of practical applications, under the theme of sustainable intensification including:

- Improved monitoring and detection of crop productivity;
- Monitoring and optimisation of farming practices;
- Audit at a national and regional scale, and
- Improved supply chain traceability and audit.

[1] GSA (2017). *GNSS Market Report 5* reports that the Association for Unmanned Vehicle Systems International estimates that farms will account for an 80% share of the total commercial drones market. Please see for details: https://www.gsa.europa.eu/system/files/reports/gnss_mr_2017.pdf

Market opportunities in agri-tech should be considered separately for the design, manufacture and operation of GNSS, EO, and Satcom technologies on the one hand and the applications of this data within the agricultural context and the manufacturing of equipment further downstream on the other. This market briefing is focused on the opportunities for UK firms in the downstream segments of the value chain both within the UK and globally. It covers the 2016-2030 period.

2 Market overview

2.1 The case for agri-tech

Climate change and a growing global population with rising incomes means that the UK and the world are facing unprecedented agricultural challenges in the coming decades.

Together, these pressures will increasingly place a strain on agricultural supply and encourage investments in innovations that can help increase yield and reduce input and environmental costs. Agricultural science and technology, known as 'agri-tech' – in particular that enhanced by satellite enabled services – can help offer a solution.

This is best demonstrated by precision agriculture, where farmers can better allocate inputs (e.g. seeds and fertilisers) to specific cropland areas based on soil type, fertility levels and other characteristics of that site using a variety of data from GNSS, EO and satcoms. This enables farmers to maximise yields with fewer input and environmental costs. For example, the use of Copernicus data has been shown to increase farming productivity by up 20%[2]. For the UK specifically, GNSS guidance systems – one particular application of GNSS in agriculture – have been shown to offer net economic benefits of at least £2/ha on a 500ha farm, and the net benefit from the whole system of GNSS guidance and variable-rate fertiliser application of around £19/ha for a 750ha farm[3].

Consumers are also becoming increasingly more conscious of, and indeed more willing to pay, for food that, because of technologies like agri-tech, meets higher ethical and environmental standards. Indeed, some studies suggest that consumers' willingness to pay for such food could support price premiums of up to 20%[4], thereby offering farmers that use agri-tech a double dividend in the form of cost savings and potential revenue increases.

At the macro level, crop yield data could be used by investors and commodity traders to make profitable investment and hedging decisions that smooth markets, reduce agricultural commodity risk and dampen the price fluctuations faced by consumers.

Agri-tech also has a number of uses among public authorities. Earth observation in particular can be used by UK public authorities to: i) adopt more efficient land subsidy policies and to monitor existing controls; ii) assess changes in crop locations and monitor any issues that could pose a risk for national or international food security; iii) to monitor carbon absorption of plants for the purpose of climate change emissions monitoring, and iv) monitor waterways at risk of agricultural fertiliser runoff.

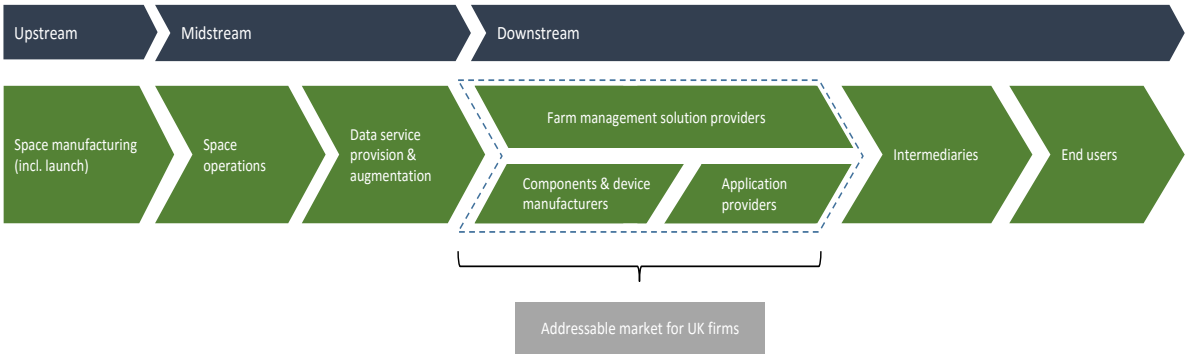
For this reason, satellite-enabled agri-tech has attracted significant investment[5] and is one of the world's fastest growing sectors and, along with satellites, has been strategically identified by the government as one of the Eight Great Technologies in which the UK is set to be a global leader.

[2] European Commission (2016). Copernicus Market Report, November 2016.
[3] Knight, S.; Miller, P.; Orson, J., (2009), An up-to-date cost/benefit analysis of precision farming techniques to guide growers of cereals and oilseeds. HGCA Research Review 2009 No. 71, pp. 115. Available at: http://www.hgca.com/publications/2009/may/20/an-up-to-date-costbenefit-analysis-of-precision-farming-techniques-to-guide-growers-of-cereals-and-oilseeds.aspx
[4] Hiscox, J., Broukhim, M., Litwin, C., (2011), *'Consumer demand for fair trade coffee: new evidence from a field experiment using eBay auctions of fresh roasted coffee'*, Harvard University
[5] Agri-food technologies attracted a total of $3.2 billion in investment in 2016. Please see: https://research.agfunder.com/2016/AgFunder-Agtech-Investing-Report-2016.pdf

2.2 Value chain

In order to understand the opportunities for UK firms in agri-tech, we must first understand the constituent markets that make up its value chain. The value chain for agri-tech (see Figure 1 below) can be classified into eight segments: space manufacturing, space operations, data service provision & augmentation, components & device manufacturing, applications, farm management solutions, intermediaries, and end users.

Figure 1 Stylised agri-tech value chain



2.2.1 Upstream and midstream

Space manufacturing and operations

The value chain starts with the manufacturing, launch and operation of satellites, subsystems and ground infrastructure that produce GNSS, Earth Observation and satellite communications data. This data is then used to support applications downstream:

- **GNSS:** Global Navigation Satellite Systems (GNSS) is an umbrella term describing an infrastructure that provides positioning, navigation and timing (PNT) information via satellites orbiting in space. This information allows users with a compatible receiver (e.g. Smartphone) to determine their position, velocity and precise universal and local time.
- **Earth Observation:** Earth Observation (EO) refers to the use of remote sensing technologies to monitor land, marine and atmosphere. Satellite-based EO relies on the use of satellite-mounted payloads to gather imaging data about the Earth's characteristics.
- **Satellite Communications:** Satellite Communication systems (Satcoms) use satellites to relay and amplify radio telecommunications between a source transmitter and a receiver at different locations on Earth. As such, satcoms offer reliable internet coverage in rural areas without cellular broadband coverage. In the future, satcoms will be used to support the IoT application in agriculture, particular where real-time monitoring is required.

Agri-tech applications utilises these existing satellite infrastructure so do not require separate GNSS, EO or Satcom satellites or payload. This report will therefore not consider space manufacturing and space operations in any more detail from this point onwards.

Nevertheless, the space manufacturing and operation segments will likely see some growth in the next few years. This is because: i) the diminishing price of data in the downstream may encourage large downstream companies to enter the upstream in order to provide a fully integrated service,

and ii) satellite infrastructure will need to become more responsive to the specific needs of increasingly sophisticated satellite-enabled applications.

Satellite data service provision and augmentation

To make the satellite data from the upstream viable for agricultural applications, the data must be processed and/or augmented. The type of service / augmentation is different for GNSS, EO and satcom data as detailed below:

- For GNSS data, satellite augmentation services are used to increase the precision and repeatability of GNSS for precise field machine operations (for guidance systems, pass accuracies must be below +/-10cm[6]). Differential Global Positioning System (DPGS) and Real Time Kinematic (RTK) are local satellite augmentation service systems and can increase GNSS positioning precision to +/- 2-5cm. These are land based systems which employ two or more GNSS receivers to refine position accuracy, where one receiver operates as a base station and the other is on a moving farm asset.
- For EO data, this segment comprises operators that acquire raw EO data and process it into information that can be combined with other statistical information (that users can interpret – such as standardised vegetation indexes and brightness maps), stored, distributed and then exploited by application providers.
- For satcom data, data service providers include networks operators, such as telecommunication companies or specialised satellite service companies, who lease capacity from satellite operators and build and operate a separate network infrastructure that allows satcom data to be exploited by application and value-added service providers and end users.

Agri-tech does not require any additional data processing or augmentation services so this report will not consider this segment in any further detail from this point onwards.

2.2.2 Downstream

The focus of this report is on the downstream which describes the hardware and software applications needed to exploit satellite signals and data by end users and represents the largest value chain segment for agri-tech. As shown in Figure 1 above, the downstream is further divided between farm management solution providers, component and device manufacturers, application service providers, intermediaries, and end-users.

Components & device manufacturers

Component manufacturers are companies who develop and manufacture discrete components, such as GNSS receivers and sensors, which can then be integrated with other components into standalone devices, machinery and other agricultural systems.

Device manufacturers integrate satellite data capabilities and components into larger products, such as tractors, spraying equipment and handheld monitoring devices.

[6] Knight, S., Miller, P., Orson, J. (2009). An up-to-date cost/benefit analysis of precision farming techniques to guide growers of cereals and oilseeds is provided. Available here: https://cereals.ahdb.org.uk/media/276988/rr71-final-project-report.pdf

Application providers

Application providers provide value-added services and software products that exploit satellite data for use by end users. These applications typically provider end-users with critical data that can ensure operations are more insight driven and therefore more productive and efficient.

Given the UK's strength (as detailed below in section 3), this will be a particularly lucrative market for UK industry.

Farm management solution providers

Farm management solution providers provide turnkey solutions for end users by supplying integrated hardware and software which support the storing, sharing, and exploitation of GNSS and sensor data. This information is then communicated to end users to direct agricultural activity, or enable automatic adjustment of agricultural equipment or inputs in the case of automatic steering and variable rate applications. Since these providers integrate hardware and software, they represent a vertical integration of component and device manufacturers, and application providers.

Intermediaries

Intermediaries – such as national farming bodies, agronomists, insurers, vendors, retailers and cooperatives – play an important role in what is otherwise a complex and fragmented downstream value chain. They can act as the bridge between: suppliers of equipment, services and inputs; and end users that need access to these products and services[7]. In this way, intermediaries are able to perform three important roles:

1) **Intermediaries as traders**: offering end users an assortment of products and services that can be or have already been acquired from manufacturers and service providers higher up the value chain. By independently creating, recommending or providing advice on different bundles of products (given expertise as agronomists that help farmers to interpret the data), intermediaries can reduce the transaction costs between suppliers and end users. Commercial intermediaries (e.g. vendors and retailers) can also support other commercial functions, including export, wholesale, import, retail, finance and insurance.
2) **Intermediaries as distributors:** commercial intermediaries, such as vendors and retailers, can help product and service suppliers to identify end users, establish relationships and secure sales on behalf of the product and service suppliers.
3) **Intermediaries as brokers:** intermediaries that work at a higher network level (sector wide) can be important in coordinating sector wide changes in the industry. They can facilitate: the articulation of needs from potential end users, options of desired change at the system level, help broker networks of diverse actors (industry, policy, research and others) and support the learning process among the agricultural community. In this way, they can help stimulate demand for agri-tech and create the enabling environment that supports the sustainable use of this technology in the sector.

[7] Kilelu, C., Klerkx, L., Leeuwis, C., Hall, A. (2011). Beyond knowledge brokerage: an exploratory study of innovation intermediaries in an evolving smallholder agricultural system in Kenya. Available here: https://assets.publishing.service.gov.uk/media/57a08ada40f0b649740007ea/riu-knowledgebrokers-catherine.pdf

End users

The relatively small size of the addressable UK market means that UK firms should consider the customer base in global terms.

End users are split between public and private players. Public players include governmental authorities that could use agri-tech to monitor regional food security, drought and land subsidies, while private players include farmers, agricultural corporations, food companies, agricultural commodity traders and agricultural investors that need to monitor crop yields, manage farming inputs and make investment decisions.

Farmers account for the majority of private end-users for agri-tech, but the cost of agri-tech is still high for all but the largest farms. This means that the addressable market is limited by the size of farms. The GSA, for example, suggest that GNSS applications to agriculture are viable for farms above 50 ha. To put this in perspective, globally 84% of farms are smaller than 2 ha, and operate about 12% of the world's farmland. In countries at lower levels of income – East Asia and the Pacific (excluding China), South Asia, and Sub-Saharan Africa – the proportion of farms smaller than 2 ha stands at about 70–80% of farms and accounts for a larger proportion of total agricultural land at about 30–40%.

It is also clear that the market for agri-tech, and indeed that which is most addressable for UK companies, is considerably broader than the farming community. However, market data on the size and opportunities for UK companies that may wish to supply non-farming end users, in particular agriculture investors, commodity traders and both international and national public bodies – is much more difficult to come by. It should therefore be noted that this has constrained the depth of market analysis that has been possible for these end users in the rest of this report.

2.3 Agri-tech applications

There are a number of different applications which use GNSS, EO and satcom data – either on their own or in combination – to improve the sustainable intensification of agriculture. Key satellite enabled applications include[8]:

2.3.1 Applications for farmers

- **Control traffic management:** uses GNSS positioning to assist drivers to follow the optimal path with use of a digital display, thereby minimising potential overlaps and input costs.
- **Automatic steering:** takes over the steering of the farm equipment from the driver allowing the operator to engage in core agricultural tasks.
- **Variable rate application:** combines GNSS positioning with information from other sensors and digital maps to distribute the right amount of agrichemicals.
- **Crop and yield monitoring:** enables site-specific monitoring of harvest, combining the output of a yield sensor with GNSS positioning of the harvester. More specifically, optical sensors allow several parameters related to crop and vegetative health to be monitored. These include the Lead Area Index (LAI), which expresses the amount of leaf area per ground surface, and the Normalised Difference Vegetation Index (NDVI), which is an indicator of the presence and health of vegetation. These parameters can be fed into crop

[8] GSA (2015). *GNSS Market Report, Issue 4.* Available here: https://www.gsa.europa.eu/market/market-report

models, which estimate the amount of water lost through evaporation from soil and plants. This can be used to direct irrigation patterns and fertiliser use.

- **Biomass, nutrient and soil condition monitoring:** GNSS positioning enables site-specific monitoring of biomass and soil quality in an agricultural field, providing up-to-date information on crop development.
- **Livestock tracking and virtual fencing:** use a GNSS-enabled portable equipment to track livestock movement and behaviour, leveraging tracking and virtual fencing.
- **Farm machinery monitoring and asset management** use real-time GNSS information for monitoring the location and status of equipment and to manage work flows efficiently.
- **Aerial spraying/mapping:** UAVs are used in precision farming support, encompassing a wide range of applications, including crop and field analysis, mid-season crop health monitoring, health assessment, planting, crop spraying and cattle herd monitoring.
- **Connecting agricultural devices:** the Internet of Things is the connectivity of physical devices to collect and exchange data between them. This providers farmers with an opportunity for to monitor their crops and increase productivity.
- **Satellite Communications:** satellite communications offer reliable internet coverage in places without cellular broadband coverage. This provides access to the internet, underpinning all other agri-tech applications which are internet-dependent. The concept of the 'connected farm' – where connectivity will support the integration of different agricultural activities and systems – and the productivity gains that it implies represents an advanced application of satellite communications in agriculture.

2.3.2 Applications for the public sector (government)

- **Field definition:** the activity of measuring precisely the boundaries and the size of agricultural fields. In the EU, this application can be used to correctly allocate and verify the area-based subsidy system for farmers under the Common Agricultural Policy (CAP).
- **Natural hazards protection:** measures of moisture, soil quality and natural resources can be used to model natural hazard events, thereby contributing to more effective disaster risk management and emergency response.
- **Landscape protection and land development:** the use of indexes based in water, soil and natural resources can be used develop systems to evaluate and to survey ecosystems of special fragility.
- **Water management and drought monitoring:** space technologies can provide solutions for a better monitoring and more efficient use of the water resources - high spatial resolution satellite images are well suited to monitor the crop development and to derive crop evapotranspiration data. This information can be used to conserve water use, thereby reducing the costs of irrigation.

2.3.3 Applications for farmers

- **Risk management systems for insurance purposes:** remote sensing and satellite imaging, can be used to calculate a variety of climatic indexes and parameters, which can be used as underlying variables in insurance policies.
- **Geo-traceability:** enhances the effectiveness of food, animal and product traceability by using transponders on animals and vehicle GNSS trackers, as well as by geo-referencing the location and size of land parcels.

3 Market opportunities

3.1 Market size and forecast growth

The total size of the agri-tech market is difficult to estimate because it encompasses a number of different satellite technologies (GNSS, EO, satcoms) and covers several distinct market segments as detailed in the agri-tech value chain (see Figure 1). Nevertheless, it is possible to provide an approximate estimate of the market size (Table 1) by analysing the size of some of these constituent markets.

Table 1 Revenue projections for the agri-tech market

Global	2016	2017	2020	2030
Precision agriculture revenue				
Device revenue	£1.2bn	£1.4bn	£2.1bn	£3.9bn
GNSS Augmentation service	£0.4bn	£0.4bn	£0.6bn	£1.8bn
Software	~£0.5bn	~£0.6bn	~£1.5bn	~£4.7bn
Agriculture EO revenue				
Value-added service	~£0.2bn	~£0.2bn	~£0.4bn	~£0.7bn
Total	**~£2.3bn**	**~£2.6bn**	**~£4.6bn**	**~£11.1bn**

Note: Market size forecasts were estimated in originally Euros. GBP estimates for 2016 were obtained using the 2016 average exchange rate of £:€ = 1:1.22. All forecast figures (2017-2030) were obtained using the 13/04/2017 exchange rate of £:€ = 1:1.18. The long-run exchange rate may be higher than this.

Source: The global revenue projections for agriculture GNSS revenues are derived from the forthcoming GSA GNSS Market Report Issue 5, and analysis of annual reports of major market players

3.1.1 Precision agriculture devices

The European GNSS Agency (GSA) have estimated the size of the global precision agriculture market in their (forthcoming) *GNSS Market Report Issue 5*.

Global precision agriculture market

The total worldwide market for precision agriculture devices in 2016 was worth £1.2bn in 2016. The high average device price of automatic steering technologies means that it accounts for half of these revenues (£653m) with about 100,000 device shipped over that period, while tractor guidance technologies follow with 27% of total precision agriculture revenues (£357m) for about 155,000 shipped devices. This is followed by Variable Rate Technologies (VRTs) which reached 67,000 shipments in 2016 for a 20% share of total market revenues (£262m) in this market.

By 2025, the total precision agriculture device market is expected to grow by an average CAGR of 11% to £3.3bn. VRT revenues will grow at a comparatively faster 17% CAGR to reach £1.0bn, while tractor guidance technology revenues will grow relatively more slowly at 6% CAGR over the 2016-2025 period. Asset management technologies are also expected to grow significantly over this period, but the low device price means that they will still only constitute 4% of total PA revenues by 2025.

Precision agriculture market by region

This growth in device revenues suggests the precision agriculture device market could represent a lucrative opportunity for UK companies, but this opportunity varies significantly by region.

North America is currently the most technologically advanced region and the centre of precision agriculture, with the highest installed base, followed by Asia-Pacific. The shipments in North America will increase more than two fold between 2015 and 2025, proving that precision agriculture is becoming increasingly prominent among farmers from this region and that the industry is committed to technological innovation.

North American companies dominate device sales in this market, and while companies like John Deere maintain a strong international footprint, there is still an opportunity for the UK to develop a presence in regions where the penetration of precision agriculture is comparatively lower.

Asia-Pacific, for example, will continue to expand its installed base, albeit at a slower pace than in the period 2006-2015, reaching 330,000 shipments in 2025. Countries such as China, India and Australia are the main adopters of precision agriculture in Asia-Pacific, driven by rising human populations and economic growth which has fuelled new dietary aspirations. The smallest farms, which is the case of most farms in the Asia-Pacific region, have the smallest capacity to purchase and indeed benefits from precision agriculture. This is because of difficulties in obtaining investment finance and the fact that the benefits of PA are often proportional to farm size. However, these farms will be the first ones to become mainstream adopters of autonomous feeding systems and will present a significant and untapped market for any UK company that can produce a low-cost innovation that is suitable for small holdings.

Europe will grow at a moderately more sustained pace, reaching 157,000 shipments in 2025. The challenges faced by precision agriculture in Europe concern the size and diversity of the agricultural market. For example, the UK is dominated by holdings of less than 500 hectares and the average utilised agricultural area per holding is around 80 hectares. The benefits from agri-tech are low at this scale so the domestic UK market that is addressable is relatively small. For this reason, UK firms that are interested in this market should think in global terms. Nevertheless, this presents an opportunity for those companies that are able to develop agri-tech that can deliver benefits for small holdings.

The Middle East and Africa, together with South America and the Caribbean will see the highest growth, partly due to the currently low levels of adoption and the fact that technologies from the developed world is becoming more accessible. In the MEA, for example, shipments will grow from 14,000 in 2015 to 239,000 in 2025. Affordable and smart technology solutions are gaining ground in Africa, a region with much untapped potential. Maize and rice are amongst the crops that have benefitted from advanced technologies.

The addressable GNSS market

For devices, the addressable market for the UK is likely to be very small (<1%) since the market for GNSS devices is highly concentrated and dominated by large North American companies which helps to explain the high penetration of precision agriculture in this region. However, if we broaden our definition of UK companies to include foreign companies that have a UK presence – such as **Hexagon** and **Trimble** – than the proportion of the market that is addressable by businesses with UK activities is much larger.

3.1.2 Precision agriculture software

In principle, all of the software revenue is addressable for UK companies because of the relatively low barriers to entry. However, this market is also dominated by large non-UK incumbents so the addressable market is likely to be <3% of the precision agriculture software revenues provided in Table 1 above.

3.1.3 Earth observation market

The revenue projections for the agriculture EO market is derived from figures from the EARSC Earth Observation survey (2015), though the lack of agriculture-specific figures mean that the above estimates should be interpreted as ROM.

In 2012, three companies captured approximately 70% of the total global revenue for EO commercial data sales: GeoEye (25%), DigitalGlobe (25%) and Astrium GEO-Information Services (20%). In February 2013, GeoEye and DigitalGlobe completed their merger, creating a global industry leader. Astrium and e-GEOS are the leading players in Europe holding over 70% of overall market share. Planet (acquired Rapid Eye in 2015), DMCii, Elecnor Deimos are the other relevant market players. Even so, these commercial revenues should be understood in the context of an EO environment that is made up of both commercial and free data sources that are provided by public authorities, with the latter including the Sentinel and Landsat satellites. The growth of the commercial data sales is therefore linked to developments in these public programmes.

The European Space Agency's (ESA) Sentinel satellites are changing the ways and business cases of how EO data is being used across agriculture. This data (both optical and SAR) is freely available to users providing data globally every 4 to 6 days. This growing bank of data is enabling routine monitoring at the field or sub-field scale right across the growing season, critical to identifying the onset of crop stress, or the need for fertilisation. This freely available data is increasing awareness and therefore uptake of EO data. This intern is leading to commercial satellite data providers having to create new data access models or value added services to their data to make it commercially viable to users.

All value-added services are in principle addressable by the UK. This is especially true given i) the UK's relative strength in this area; ii) the strong science base, and iii) the existence of supporting institutions like the **Centres for Agricultural Innovation** (see Box 1 below), the **Centre for EO Instrumentation and Space Technology** (a partnership led by **Airbus DS** together with the **University of Leicester**, **STFC/Rutherford Appleton Laboratory** and **QinetiQ**).

Box 1 UK Centres for Agricultural Innovation

The Centres for Agricultural Innovation are a new collaborative model between the agri-tech sector and government. They comprise:

- **The Centre for Crop Health and Protection –** to support farmers to better manage crop threats such as pests and diseases;
- **The Centre for Innovation Excellence in Livestock** – to create new livestock technology and products that improve livestock farming profitability and productivity;
- **The Agricultural Engineeering Precision Innovation centres –** to help the UK's agri-food sector develop technologies that will increase the productivity and sustainability of UK agriculture;
- **Agrimetrics –** focused on the use of data science and modelling to help build a more productive, sustainable and efficient food system.

As well as increasing the UK's capacity for translating agricultural innovations into commercial opportunities, the centres are intended to stimulate inward investment and help improve UK farming practice.

Source: Department for Business, Energy & Industrial Strategy. Please see: https://www.gov.uk/government/publications/centres-for-agricultural-innovation/centres-for-agricultural-innovation

Although commercial data sales is globally dominated by large players (such as DigitalGlobe in the US and Astrium in Europe), analysis by SpaceTec partners[9] indicates that there is scope for competition by a range of mid-sized and smaller players (Planet, DMCii).

3.2 Competitive landscape

3.2.1 Augmentation service providers (RTK)

The market for augmentation service providers and GNSS receivers is relatively mature with large global companies dominating. It is hard to see where the UK could intervene in this consolidated market. However, UK companies could cater to the domestic market as GNSS Open Services offers a free RTK service link to commercial service providers. **Veripos** (recently acquired by Hexagon) was a UK-based DGNSS service provider offering augmentation data in the North Sea Oil & Gas domain, but may be able to sell similar services to agriculture end users.

3.2.2 Farm management solution providers

Across the agri-tech market there a several companies which dominate over multiple segments of the value chain, integrating both hardware manufacturing and applications service provision as farm management solution providers. In most cases they are large navigational service providers such as Trimble and Topcon, but there are also other smaller but well established players such as AgSpace, SOYL Precision Farming, and GEOSYS. However, agricultural companies have been found in early stages of the value chain. Deere & CO are the largest agricultural machinery company in the world and appear at all points in the value chain, including as augmentation service providers and component manufactures. Trimble and Hexagon (Leica Geosystems) are large navigational service providers and are also active in all parts of the value chain except for agricultural equipment.

[9] SpaceTec Partners (2013). Final Extended Executive Summary: European Earth Observation and Copernicus Midstream Market Study, September 2013.

3.2.3 Component manufactures

Components manufacturing for GNSS agricultural applications is dominated by three firms – Trimble and Deere & Co of the USA, and Topcon of Japan – which together capture almost 80% of the GNSS antenna and receiver market. By comparison, Europe captures only 6% of this market. The opportunities for UK firms in components manufacturing is therefore extremely limited.

3.2.4 Manufactures of farming equipment and devices

Guidance systems such as automatic steering are one of the oldest Precision Agriculture techniques, however, the market for these technologies is very mature and dominated by a few well established players, including John Deere, Topcon, Trimble, and Agco, so it would be hard for the UK to penetrate. However, the UK does have a foothold in this market through Hexagon's UK subsidiary, Leica Geosystems, which provides machinery guidance and asset management solutions for the agricultural sector.

Similarly, precision livestock tracking and virtual fencing are still in the early stages of development, but wider adoption is possible as the technology develops. There are several cattle sensor companies based in the UK. Although most of the research originates from Australia and New Zealand, there is a strong group of sensor academics in the UK.

3.2.5 Software

The UK has a strong base of start-ups and SMEs who are involved in farm management systems that map and analyse agricultural land using EO, many of them aim to mobilise applications into mobile apps so this should be an area of continued development.

Partnerships with the dominant agricultural equipment manufacturers will be key to expanding market share for potential UK service providers and operators, as an increasing number of in-service devices are being driven by these traditional and dominant hardware manufacturers. Successful examples include the US M2M communications company Orbcomm, which partnered with John Deere to grow the number of OEM installs in tractors[10].

3.3 Routes to market for UK companies

There are a number of different routes to market for UK companies, reflecting the fragmented nature of the downstream agri-tech value-chain.

Intermediaries play an important role in the downstream value chain as a bridge between suppliers of equipment, services and inputs, and end users that need access to these products and services. However, it appears that many satellite-technology companies struggle to find a route into market. As system integrators of farming machinery, equipment manufacturers and farm management solution providers may appear to be an obvious customer for agri-tech software and value-added services. However, this part of the supply chain is characterised by a small number of very large manufacturers and early evidence from stakeholder consultations suggests that they are likely to block new market players as they have an incentive to protect their existing market share. Independent agronomists and other agricultural advisors are an option but the most successful

[10] Please see: http://www.satnews.com/story.php?number=1169169932

products that have come into market have come through collaborations between agricultural experts that understand end-users and technology companies.

End users are in turn split between public and private players.

Farmers account for the majority of private end users for agri-tech. However, the viability of farmers as a route to market depends on their scale of operations because of differing levels of investment capacity and the fact that benefits are often proportional to farming scale.

The willingness and indeed capacity to pay for agri-tech also varies significantly by region. The willingness to pay for agri-tech is likely to be highest in Europe and North America were labour shortages incentivise investments in cost-saving technologies, however, farmers in these countries have often already achieved high-levels of productivity so the scope for growth is likely to smaller. On the other hand, the willingness to pay for agri-tech is likely to be lower in developing countries. As such, the potential for growth is likely to be higher since agri-tech penetration is much lower and the scope for productivity gains much higher than in the developed world. The developing world is also characterised by a cheap and plentiful supply of labour so the value proposition for agri-tech is linked more the promise of increased resilience and lower crop risk and less to cost saving.

On this basis, governmental authorities and agencies, large scale farms, agricultural corporations, agricultural commodity traders and agricultural investors are likely to represent the core addressable market for UK agri-tech firms.

Partnerships are vital to the value chain, since not even the largest suppliers can fulfil all the needs of end users by themselves (e.g. sophisticated technology that can be used by farmers) and must cooperate to achieve this.

If farmers are to become viable customers, agri-tech will need to be developed to deliver value for small holdings and much more of the intangible environmental benefits from agri-tech would need to be monetised through government pricing schemes and regulation. The first of these challenges represents a particular market opportunity for potential UK innovators in this area.

4 Market drivers

4.1 Market dynamics

4.1.1 Global trends

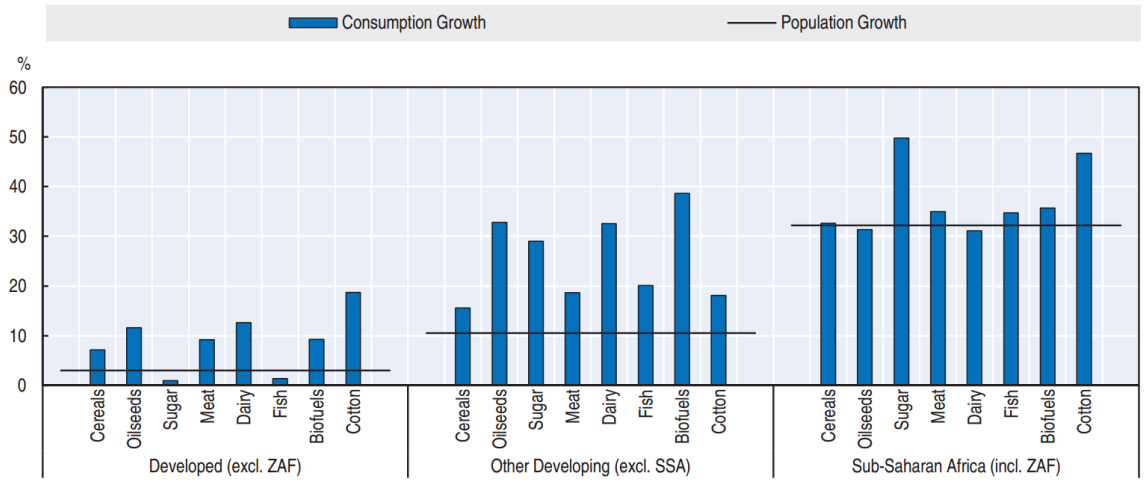
Climate change and a growing global population with rising incomes means that the UK and the world are facing unprecedented agricultural challenges in the coming decades:

- **Climate change** is leading to unpredictable growing seasons, alterations in pest and disease ranges, fluctuating weather patterns and extreme events.
- **Global population growth, urbanisation and industrialisation** is increasing demand for land at a time when climate change will already place severe pressure on it.
- **Economic growth of emerging economies** is raising aspirations for a western lifestyle, with diets changing towards more meat and dairy products and a more varied diet in general. This places increasing pressure on land, energy, water and other resources, such as fertilisers.
- **Consumers in the developed world** expect food retailers to produce food to high social, environmental and ethical standards.

Together, these pressures – as highlighted in Figure 2 below – will place a strain on agricultural supply and encourage investments in innovations that can help increase yield and reduce input and environmental costs. The scope for potential addressable market – including both public and private customers – for agri-tech is likely to increase as these pressures become more acute.

However, it is important to recognise that the adoption of agri-tech solutions has not been rapid to date. The reasons for this are primarily related to cost – only large farms can afford the investment and realise the returns – and the industry is by nature conservative (though this too is related to the volatility of the market and the difficulty in accessing finance). This is particularly true of the UK where the average utilised agricultural area per holding is small at around 80 ha.

Figure 2 Consumption growth by region (2025 vs 2013-15)



Note: ZAF refers to South Africa
Source: OECD-FAO (2016). OECD-FAO Agricultural Outlook, OECD Agriculture statistics (database). Please see: http://www.oecd-ilibrary.org/agriculture-and-food/data/oecd-agriculture-statistics_agr-data-en
http://www.fao.org/3/a-i5778e.pdf

4.1.2 Technology and market trends[11]

Alongside these global trends, the market for agri-tech is also being driven by a number of technological and market developments. Five of the most notable trends include the following:

- The current agri-tech market is **complex and fragmented**. Most of the technologies overlap but are not compatible across vendors and systems. This reflects a market that is dominated by a few mature players that are keen to 'lock-in' customers and protect their market share. There is therefore a considerable opportunity to bring these technologies together and offer a farm management system, which can integrate these different technologies and present the end-user with an easy to use interface. The UK has the technological and agricultural expertise to make sure all the systems are interconnected, compatible, and cognisant of the needs of end users.
- All major suppliers of precision agriculture solutions are currently developing **integrated farm management** solutions which describes a holistic farm management approach that relies on big data and farm asset connectivity to improve the efficiency and utilisation of existing farm assets. Current EU uptake is just 10%, but market estimates suggest this is likely reach 30-40% by 2020. This implies significant CAGR growth over the next three years which UK technology start-ups can help service.
- **UAVs** are used to support precision farming, including crop and field analysis, mid-season crop monitoring, health assessment, planning, crop spraying and cattle herd monitoring. The Association for Unmanned Vehicle Systems International estimates that farms will eventually account for an 80% share of the commercial UAV market.
- The **Internet of Things (IoT)** has been a source of new and more productive ways to farm in recent years because of increasing affordability and ease-of-installation. The US is currently dominating this segment, with CAGR growth of 20%. This growth is promising, but reflects a small starting base – the level of investment required by farmers has and will

[11] Based on data and analysis from LE's forthcoming GNSS Market Report, Issue 5 (2017) publication for the GSA.

continue to significantly limit the potential of IoT for agriculture without significant levels of government subsidies to kick-start growth and growth in distribution channels to reach remote farming communities[12].

- The **food traceability market** – which provides information on a products source to other points in the supply chain – is projected to grow at 9% CAGR by 2019. This growth is driven by western consumers that are becoming increasingly sensitive to origin of products and their ingredients, and producers that want to justify price premiums

4.2 Market drivers (PESTLE)

Political	• The political climate is becoming more hostile to barrier-free trade which could block potential opportunities for UK companies • The UK's exit from the European Union (Brexit) will have a significant impact on the agricultural sector – for example, subsidies (Common Agricultural Policy) will need to be replaced. The UK has a significant opportunity to develop a new agricultural policy that facilitate the uptake of agri-tech. • The UK Space Agency's International Partnerships Programme (IPP) provides £150m in export support for UK companies wishing to build satellite-enabled technologies in the developing world. • DEFRA is perceived to be an underpowered advocate of agriculture within government. Agri-tech – as a potential commercial opportunity for UK companies – may be better promoted by other departments (BEIS, DTI). • The government could use procurement as a tool for supporting agri-tech.
Economical	• The commercial viability of agri-tech for farmers depends on the scale of farms. For this reason, the opportunities for UK companies lie outside of the UK domestic market which is characterised by small holdings. On the other hand, the small holding market could be a big prize for any UK firms that could develop low-cost technologies that are viable at this scale. • Many farmers do not see the value proposition of agri-tech– that it can offer savings in the long run and/or improve crop yields – when confronted by the investment decision. This issue is particularly acute for innovations that give farmers access to data and not just mechanisation, where the long-run returns are often higher but less visible in the short-run. Communicating the potential long-run profitability of agri-tech could support its uptake among UK farmers. • The value proposition for agri-tech also differs substantially between developed and developing world markets. In the former, high labour costs suggest a cost-case argument for agri-tech. In the latter, where there is an abundant source of cheap labour, the value proposition of agri-tech must focus on reducing risk and improving the resilience of farms.

[12] Please see: http://www.satnews.com/story.php?number=1169169932

Social	• Farmers will sometimes have a strong preference for crops regardless of the economics. This desire for agency over crop choice must be acknowledged. • Agri-tech approaches which encourage a bottom-up as well as top-down exchange of data will enhance the overall volume and power of data and could be an effective way of engaging farmers in agri-tech. However, the privacy, data ownership and technical issues associated with this would have to be addressed. • Educating UK farmers on the benefits of agri-tech could encourage uptake, particularly when many report scepticism about the value proposition. • Farmers in rural areas face increasing levels of social isolation. Agri-tech could therefore bring substantial wellbeing benefits for farmers if used to connect communities.
Technical	• Poor internet connectivity in rurual areas remains a huge constraint on the adoption of powerful IoT and connectivity technologies that can integrate sensors and coordinate farming assets across farming estates. Rural connectivity is not profitable for telecommunication companies so investment must come from government or from farming communities directly. The potential cost of this could further dent the attractiveness of connectivity technologies. • The poor usability of some agri-tech, sometimes a product of incompatibility across platforms, result in large set-up times which would wipe out some of the time and cost savings that the technology may be intending to deliver. • Many of the technologies that are currently billed as ‘agri-tech’ come from outside the sector, exacerbating the usability problem for end users.
Legal	• UK agricultural policy and legislation will have to developed post-Brexit to accommodate new technology developments. For example, there remains huge uncertainty around the level of subsidies, regulations and access to EU labour which will impact agri-tech investment decisions and the uptake of technologies like UAV that are currently constrained by regulation. • Some of the most important agri-tech innovations will utilise bottom-up as well as top-down data exchange. The uptake of this by end users depends on trust so will, be determined by the model of data ownership, sharing, and licensing that is adopted.

Environmental

- Climate change
- Large retailers in the developed world have a potentially large role to play in encouraging the uptake of agri-tech. This is because consumers in the developed world are becoming increasingly more response to the ethical and environmental cost of produce. There is therefore a commercial opportunity for retailers to encourage the uptake of agri-tech across their global supply chain if they can demonstrate the environmental and cost savings that are associated with this.
- Agri-tech also has a number of uses among public authorities concerned with climate change. Earth observation in particular can be used to: i) assess changes in crop locations and monitor any issues that could pose a risk for national or international food security; ii) to monitor carbon absorption of plants for the purpose of climate change emissions monitoring. Similarly, space technologies can provide solutions for a better monitoring and more efficient use of the water resources - high spatial resolution satellite images can be used to monitor the crop development and to derive crop evapotranspiration data. This information can be used to conserve water use, thereby reducing the costs of irrigation. This represents a potentially large market opportunity for UK firms.

4.3 SWOT analysis

Strengths

- Creative and entrepreneurial nature of 'UK Plc' – there is already a strong base of software and value-added technology companies that can apply expertise to solve agricultural problems
- **Agri-tech Centres** (see **Error! Reference source not found.**) already provide a strong supportive environment for agri-tech
- Strong expertise is sensor technology which can be applied to the industry
- Strong academic base at universities and agricultural colleges
- Availability of private financing (even if accessing it remains difficult because of the weakness of commercial proposals)
- A number of varied funding mechanisms (although they are highly competitive, support to access them is weak and many companies and research institutions are unable to progress beyond the proof of concept stage towards full commercialisation)
- UK farmers represent a testing-bed for agri-tech exports
- Aid for trade (e.g. UK Space Agency's **International Partnerships Programme**)
- Brexit may help redistribute the intellectual focus of the UK towards the developing world were the potential for commercial agri-tech is greatest.

Weaknesses

- Cost of equipment still remains the biggest barrier to adoption of agri-tech
- Farmers as end-users require further information and demonstration on how to use technologies
- Agricultural market is volatile which restricts the capacity for farmers to invest. Farmers are therefore reluctant to alter existing investment plans.
- Small UK farms are the largest domestic market but have the smallest return on investment
- The agricultural industry require more support when it comes to writing commercial business cases – this is identified as a significant weakness in the sector
- Academics often lack the expertise or the incentives to take research ideas and technologies to market
- Industry often lack the technical skills and expertise to support the agri-tech industry
- Agriculture could have stronger champions in government (perception that DEFRA is underpowered)
- Agricultural research is fragmented – there are a variety of different research centres but they lack focus and agri-tech could feature more prominently
- Farmers are still not persuaded by the value for money case for agri-tech – many are aware of the benefits but are deterred by the high investment costs
- The industry lacks big data and analytical expertise – the industry needs this if it is to produce products that utilise this data to support farmers to make decisions

Opportunities

Developed world (incl. UK):

- Growing labour shortage and the increasing price of other agricultural inputs support the case for investments in cost-saving agri-tech
- Western consumers have demonstrated a willingness to pay for food that has been sourced more sustainably and with fewer environmental costs so retailers may be able to incentivise the uptake of input-saving agri-tech by paying agri-tech farmers a premium for their produce without eroding marigns
- Research by London Economics and the Satellite Applications Catapult suggests that farmers understand the benefits of agri-tech and that barriers are instead linked to cost, usability and compatibility. There is scope for UK agri-tech to address each of these barriers.

Developing world:

- The UK Space Agency's IPSP fund has provided a large sum of money to support the development of technologies that use satellite data for economic and societal benefits in developing countries
- International aid and other governmental agencies will need to mitigate the impact of climate change and agri-tech represents one possible solution

Threats	
	• Brexit represents a potential barrier to the attraction of top technology talent • Farmers remain unpersuaded of the business case for agri-tech • Size of most UK farms means that the UK farmers are not viable customers for most agri-tech (cannot achieve economies of scale to make investment viable) • UK financing remains more risk averse than the US • Opportunities for agri-tech export and cross-border collaboration could be threatened by a political climate that is increasingly protectionist

5 Growth potential

5.1 Evidence for growth / potential value

The collection of market reports reviewed for this report all predict that precision farming will be growing at a double digit rate. There is a wide range of estimates, due to the differences in definitions and location of the markets review, but overall there is strong evidence to suggest that the market will more than double in value to over £11bn by 2030.

The precision agriculture device market alone is expected to grow at 11% CAGR to reach a size of £3.9bn by 2025.

These projected growth rates are supported by evidence from a BCG report that finds that 60% of farmers believe that farming will be widely adopted by 2030[13].

5.2 Market blockers

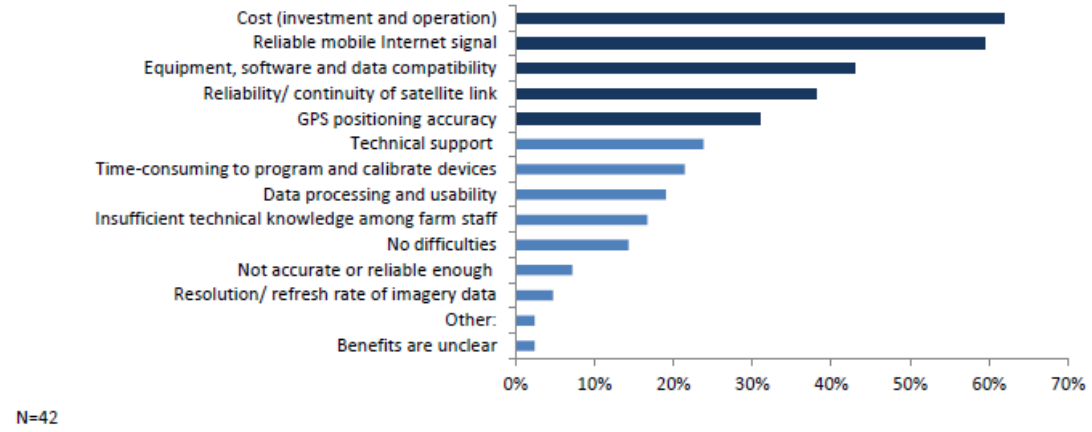
Despite evidence of a large and growing opportunity in the agri-tech market over the next few years, there is also evidence of a number of market barriers that could prevent UK companies from fully exploiting this potential.

For UK domestic market in particular, industry reports that many UK farmers are unaware of the benefits of satellite-enabled agri-tech. This is a particular problem because agri-tech normally requires a large upfront investment from often finance constrained farmers. In this situation, investments in agri-tech become very difficult to justify.

Similarly, a survey by London Economics and Satellite Applications Catapult found from a survey of 50 UK farmers that one of the biggest difficulties relating to Agri-tech came from cost and reliability of mobile internet[14], lending support to the conclusion that technology costs remains the largest barrier to the adoption of agri-tech, certainly within the UK domestic market. To be economically attractive, agri-tech innovations have to display the potential to create value in the marketplace[15].

[13] Corsini, L., Wagner, K., Gocke, A., Kurth, T. (2015). *Crop Farming 2030: The Reinvention of the Sector*. Available here: https://www.bcgperspectives.com/content/articles/process-industries-innovation-crop-farming-2030-reinvention-sector/
[14] London Economics & Satellite Applications Catapult (2015). *Satellite technologies in UK agriculture*. Available here: http://londoneconomics.co.uk/wp-content/uploads/2015/11/LE-SAC-Satellite-Tech-in-UK-Agri-REPORT-FINAL.pdf
[15] Sonka, S. (2016). Big Data: Fueling the Next Evolution of Agricultural Innovation. Available here: www.open-jim.org/article/download/163/163

Figure 3 Difficulties faced when using space technologies in agriculture



Source: London Economics & Satellite Applications Catapult (2015). Satellite technologies in UK agriculture.

Beyond cost, the technical capabilities of aging farming community and the lack of compatibility of equipment are the next most reported barriers to the adoption of agriculture technology in the UK domestic market. Farmers have reported frustration with the lack of fluidity across PA technologies, as most do not integrate with each other. Many in the industry have suggested that this reflects conservative group of dominant market providers that have little incentive to risk their market share by adopting standardisation and not simply the lack of standards in general. Additionally, most of the technology has been found to be too complicated to use without substantial education or additional expertise to process and interpret the data. In order to increase adoption, UK firms must be cognisant of end user needs.

Current business models for agri-tech also limit the attractiveness of agri-tech to domestic UK farmers. This is because farmers, who are sometime financially constrained, are expected to make large upfront investments and bare all the risk in sector that is characterised by volatility. Business models that can limit this risk (e.g. leasing arrangement where payment is performance dependent) and ensure that technologies fit within the existing investment strategy of farmers are likely to be more sustainable.

Another problem concerns the nature of agri-tech relative to other cost-saving technologies that end users in the agriculture sector are used to adopting. For example, agri-tech is characterised by the provision and utilisation of satellite data to enhance agricultural productivity. This is, especially in comparison to farm machinery, a soft product and one that delivers environmental benefits that are not tangible to the farmer. Attempts to demonstrate the power of data driven agri-tech and that create a mechanism for rewarding environmental savings, through government pricing for example, would certainly encourage the penetration of agri-tech within the farming community.

UAVs for use in agriculture is also currently restricted by tough regulations. Unless these are remodelled, the use and therefore benefits associated with UAVs in the agricultural sector will be hampered. Like most other PA technologies, UAV providers have also approached the market in a rather bullish way and are in danger of overselling the technology to farmers. Each crop and livestock has individual characteristics which need a tailored approach to their care. In many cases data is clumped and generalised without going into specifics. Providers of UAVs and applications will have to develop products with agricultural expertise if the huge promise of UAVs in agriculture is to be realised.

Furthermore, following the result of the EU referendum, CAP payments which support farmers are at risk with government only securing funding till 2020. This may hinder the adoption of PA technologies as farms will make cuts to account for their loss in income.

Finally, the agricultural sector may be constrained by the level of technological and entrepreneurial expertise in the industry that can develop and commercialise data-driven applications. As is the case in other sectors, this can be sourced externally if the commercial case for engagement in the agricultural sector can be made and success stories highlighted.

6 Conclusions and recommendations

6.1 Conclusions

This market report provides an overview of the current market for agri-tech and assesses the opportunities for UK companies.

It is clear that a combination of pressures – climate change, a growing population with rising incomes – will place considerable pressure on global food supply in the coming decades. These pressures have encouraged considerable investment in satellite enhanced agri-tech applications which can help increase yield and reduce input and environmental costs.

Farmers account for the majority of potential end users, but the cost of agri-tech is high for all but the largest farms. This means that the addressable market for UK companies is limited by the size of farms. However, this presents a potentially large and untapped opportunity for companies that can develop low-cost agri-tech that can deliver benefits for small holdings across the developed and developing world. Given that the UK is characterised by small holdings, UK firms must look beyond the UK market, but should remain cognisant of the different value propositions of agri-tech in the developed and developing world.

There is also a large end user market beyond the farming community. These include agricultural investors, commodity tranders, and both international and national public bodies. However, market data on the market size and opportunities for these end users is much more difficult to come by.

The UK is potentially well placed to take advantage of this market, with a strong base of research institutions, start-ups and SMEs, a number of varied funding mechanisms (such as the International Partnerships Programme), and existing links between research institutions, the public sector and industry through platforms such as the Centres for Agricultural Innovation.

However, the successful exploitation of this opportunity will depend on a number of factors. Firstly, farmers face a number of challenges to adoption. UK firms will need to address concerns relating to cost, understanding of the value proposition, usability and the compatibility in order to penetrate this market. Secondly, partnerships with the dominant agricultural equipment manufacturers will be key to expanding market share for potential UK service providers and operators, as an increasing number of in-service devices are being driven by these traditional and dominant hardware manufacturers. The complex and fragmented nature of the agriculture industry also means that Intermediaries in the industry can play a key role in gaining access to end users, articulating needs, and distributing products.

The UK's post-Brexit landscape for agriculture also remains a big uncertainty which could hinder investments in agri-tech until that is at least clarified.

6.2 Recommendations for stakeholders

Targeted action by government, industry, academic and coordinating bodies like the Catapult could therefore be key to securing this opportunity for UK business. Specific actions that have been identified include the following:

6.2.1 Government

- Create a coordinated funding mechanism to support research and innovation in agri-tech
- Agri-tech research could be consolidated through the Agri-tech Centres
- Encourage the interoperability of standards through procurement
- Government could make the environmental benefits associated with agri-tech tangible by setting environmental protection limits and penalties, thereby putting a price on land and pollution and incentivising industry to come up with solutions
- Maintain support and free access to Copernicus data – the continuity of access will influence future investment decisions so this must be guaranteed
- Funding and advisory support mechanisms to support the commercialisation of agri-tech beyond the proof of concept stage
- Help remodel UAV regulations to allow commercial use in agriculture
- Ensure the UK's post-Brexit replacement for the CAP is designed to facilitate the commercial uptake of agri-tech
- Work with independent agricultural institutions such as Agriculture and Horticulture Development Board to support PA technologies
- Government continues to participate in the EU Horizon 2020 and future research framework programmes to ensure that UK agriculture is equipped to benefit from agri-tech

6.2.2 Academia

- Collaborate with agricultural and industry expertise
- Research into precise GNSS receivers
- Agricultural colleges to deliver courses based around precision agriculture
- Develop a library of proof of concept application (e.g. Small Aperture Radar) with government support

6.2.3 Catapult

- Defragment expertise by creating forum and special interest groups that bring government, academia and industry together to tackle challenges
- Provide industry with information on the viable routes to market for agri-tech
- Aid satellite technology and end users to collaborate to seek demand driven solutions
- Offer companies routes into international markets
- Collaborate with independent institutions – AHDB and other specialist consultants
- Conduct an independent cost benefit analysis to assess agri-tech profitability to cover the full spectrum of farm sizes
- Look into how to increase the frequency of satellite imagery
- Help companies develop business models that match with the agricultural market
- Engage with the Centres for Agricultural Innovation and ensure that they are growing the sector in a strategic way

6.2.4 Industry

- Seek end-user driven solutions – through collaborations and market research
- Then develop a secure route into market through those collaborations
- Work with computer scientists/ big data experts to develop cloud computing platform for agri-tech
- Industry needs to work with academia and colleges to develop courses that can up-skill industry and raise awareness of research needs
- Work with end users to make sure product is easy to use
- Research into precise GNSS receivers, leveraging Galileo Open and Commercial Services (to reduce end user costs)

6.3 Priorities for future research

While this report provides a detailed overview of the market opportunities for UK firms in the agri-tech market, there are at least two notable areas that could be explored further.

A priority point for future research would be a more detailed review of the market size and opportunities that exist beyond the farming community – i.e. for agricultural investors, commodity traders, and both international and national public bodies – where current market data is considerably weaker.

From this research, it is also clear that the opportunities for UK firms are outside the UK domestic market. However, this market is far from homogenous – feasible price points and potential value propositions vary considerably, not just between developing and developed world markets but also within. Each one these markets could command an entire market research project, but a starting point would be to at least map these differences in more detail than has been possible in this report.

References

Corsini, L., Wagner, K., Gocke, A., Kurth, T. (2015). *Crop Farming 2030: The Reinvention of the Sector*. Available here: https://www.bcgperspectives.com/content/articles/process-industries-innovation-crop-farming-2030-reinvention-sector/ [accessed 13 April 2017]

European Commission (2016). *Copernicus Market Report*, November 2016. [accessed 13 April 2017]

GSA (2015). *GNSS Market Report, Issue 4.* Available here: https://www.gsa.europa.eu/market/market-report [accessed 13 April 2017]

GSA (2017). *GNSS Market Report Issue 5.* Forthcoming publication.

Hiscox, J., Broukhim, M., Litwin, C., (2011), *'Consumer demand for fair trade coffee: new evidence from a field experiment using eBay auctions of fresh roasted coffee'*, Harvard University

Kilelu, C., Klerkx, L., Leeuwis, C., Hall, A. (2011). *Beyond knowledge brokerage: an exploratory study of innovation intermediaries in an evolving smallholder agricultural system in Kenya.* Available here: https://assets.publishing.service.gov.uk/media/57a08ada40f0b649740007ea/riu-nowledgebrokers-catherine.pdf [accessed 13 April 2017]

Knight, S.; Miller, P.; Orson, J., (2009), *An up-to-date cost/benefit analysis of precision farming techniques to guide growers of cereals and oilseeds. HGCA Research Review 2009 No. 71, pp. 115.* Available at: http://www.hgca.com/publications/2009/may/20/an-up-to-date-costbenefit-analysis-of-precision-farming-techniques-to-guide-growers-of-cereals-and-oilseeds.aspx [accessed 13 April 2017]

London Economics & Satellite Applications Catapult (2015). *Satellite technologies in UK agriculture*. Available here: http://londoneconomics.co.uk/wp-content/uploads/2015/11/LE-SAC-Satellite-Tech-in-UK-Agri-REPORT-FINAL.pdf [accessed 13 April 2017]

Sonka, S. (2016). *Big Data: Fueling the Next Evolution of Agricultural Innovation*. Available here: www.open-jim.org/article/download/163/163 [accessed 13 April 2017]

SpaceTec Partners (2013). *Final Extended Executive Summary: European Earth Observation and Copernicus Midstream Market Study*, September 2013. [accessed 13 April 2017]

Index of Tables, Figures and Boxes

Tables

Figures

Boxes

The Centres for Agricultural Innovation are a new collaborative model between the agri-tech sector and government. They comprise:

- The Centre for Crop Health and Protection – to support farmers to better manage crop threats such as pests and diseases;
- The Centre for Innovation Excellence in Livestock – to create new livestock technology and products that improve livestock farming profitability and productivity;
- The Agricultural Engineeering Precision Innovation centres – to help the UK's agri-food sector develop technologies that will increase the productivity and sustainability of UK agriculture;
- Agrimetrics – focused on the use of data science and modelling to help build a more productive, sustainable and efficient food system.

As well as increasing the UK's capacity for translating agricultural innovations into commercial opportunities, the centres are intended to stimulate inward investment and help improve UK farming practice.