esa

SPACE SOLUTIONS

AGRICULTURE DOSSIER

BIOECONOMY

→ THE EUROPEAN SPACE AGENCY

CONTENTS

CONTEXT AND CHALLENGES

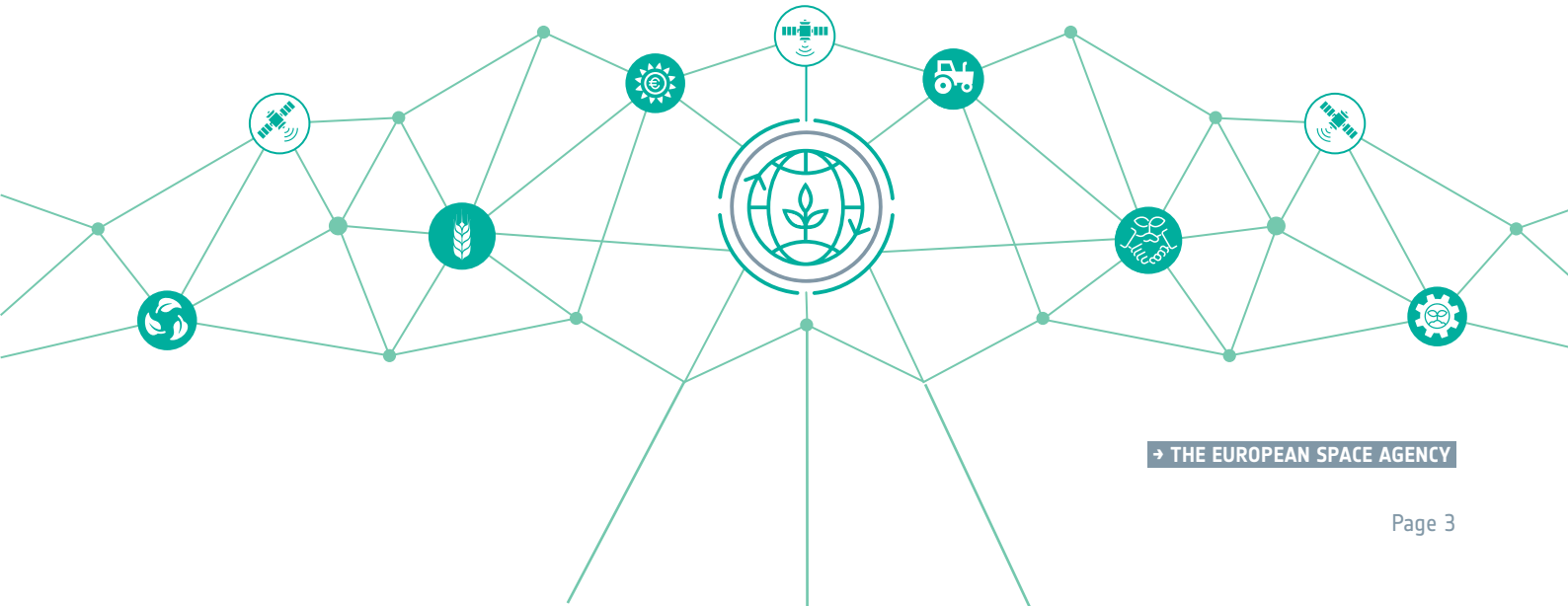
With the world's population projected to reach nearly 10 billion by 2050, the demand for food production is set to rise significantly. Agriculture plays a crucial role in shaping landscapes, economies and societies, but it is about more than simply growing food; it is about doing so efficiently and sustainably in the face of limited resources.

In recent decades, the sector has evolved from using traditional farming practices to a technology-driven industry, supporting a rapidly growing global population and leading to increasing concerns about sustainability in the agriculture sector. Agriculture accounts for nearly a quarter of global greenhouse gas emissions, and is responsible for 11% in the EU – even more than the industrial sector (9%) – so the need to develop climate-smart agricultural solutions that protect our planet is increasingly urgent.

As the sector adapts to increasing demand from growing and moving populations, there are many obstacles to overcome to ensure a sustainable future for farming.

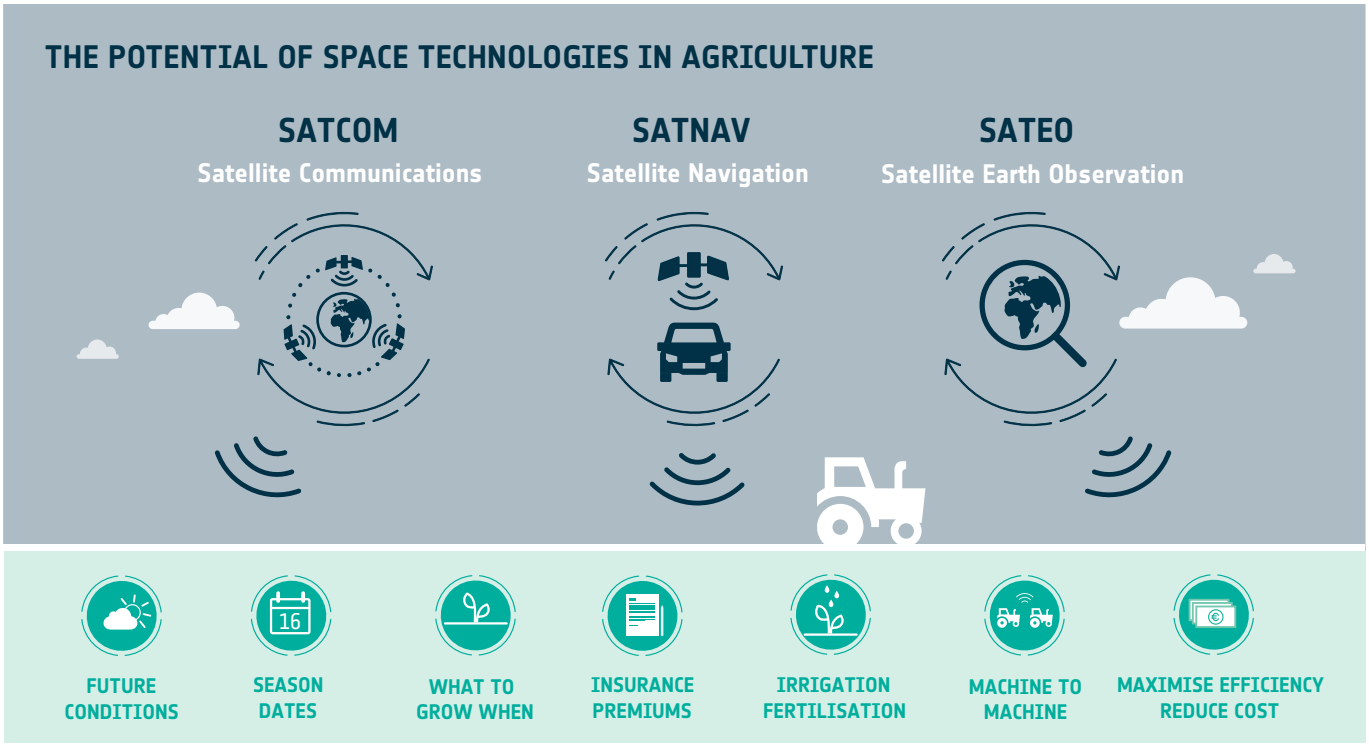
These include:

- Climate change affecting crops
- Pressure on natural resources and the environment
- Deforestation, soil degradation, and biodiversity loss from intense agricultural practices
- Ageing farming populations and labour shortages
- Waste
- Regulatory demands
- Reduced arable land through urbanisation
- Rising energy prices and other costs



THE ROLE OF SPACE

The role of space-based technology in modern agriculture is already helping the transition to a more sustainable agriculture sector and is becoming increasingly significant. Climate-smart agricultural practices — such as drought-resistant crops, precision irrigation, regenerative farming, and AI-driven monitoring — can enhance resilience and ensure long-term sustainability and many of these are driven by space. The adaptation of circular economy principles, carbon farming, or practices that allow soil health management are emerging as a viable option to mitigate environmental harm while maintaining agricultural productivity. These efforts highlight how technological progress and sustainable strategies can reshape agriculture, making it both productive and environmentally responsible.



USE OF SPACE TECHNOLOGIES IN AGRICULTURE

Satellite Navigation (Satnav)

- Enhancing the precision of autonomous machinery
- Using GPS collars and IoT sensors to monitor livestock health, location and behaviour
- Using machine learning algorithms to optimise planting schedules and crop rotation plans
- Optimising waste collection services
- Enhancing traceability and transparency in the supply chain by leveraging blockchain technology, tracking product lifecycles
- Ensuring authenticity and quality of organic and sustainably produced goods

Satellite Communications (Satcom)

- Providing internet access to rural and remote agriculture, silviculture and fisheries
- Integrating satellite data with IoT sensors for real-time monitoring and management of farm operations
- Supporting automated equipment and machinery
- Helping producers and farmers access market prices, weather forecasts and best practices through mobile and internet services
- Connecting producers with buyers and suppliers to streamline the supply chain
- Automating irrigation systems based on soil moisture data and weather predictions

Satellite Earth Observation (SatEO)

- Assessing crop and forest health, detection of diseases and prediction of yields
- Monitoring soil moisture levels and optimisation of irrigation
- Tracking deforestation, desertification and biodiversity loss
- Monitoring water quality and levels in reservoirs and rivers
- Supporting climate change mitigation efforts by providing advanced analytics for yield prediction and risk management across productive sectors
- Predicting extreme weather events

Additionally, satellite data transmission is enhancing supply chain transparency, reducing fraud, and ensuring ethical sourcing of agricultural commodities, which further supports sustainability efforts.

ESA'S BUSINESS APPLICATIONS AND SPACE SOLUTIONS PROGRAMME

10 years of space-based applications for the agriculture sector

Over the past ten years, the agriculture sector has seen one of the highest levels of investment in the BASS portfolio, comprising 126M EUR invested across 246 activities, including Demonstration Projects, Feasibility Studies and Kick-Starts. Of this, 72M EUR was invested by ESA BASS Member States and 54M EUR of investment was made by industry, users, and potential customers.

Total Investment of 126M EUR

72M/57%
Euro invested by ESA BASS

54M/43%
Euro invested by industry

Investment details at a glance

22
Countries

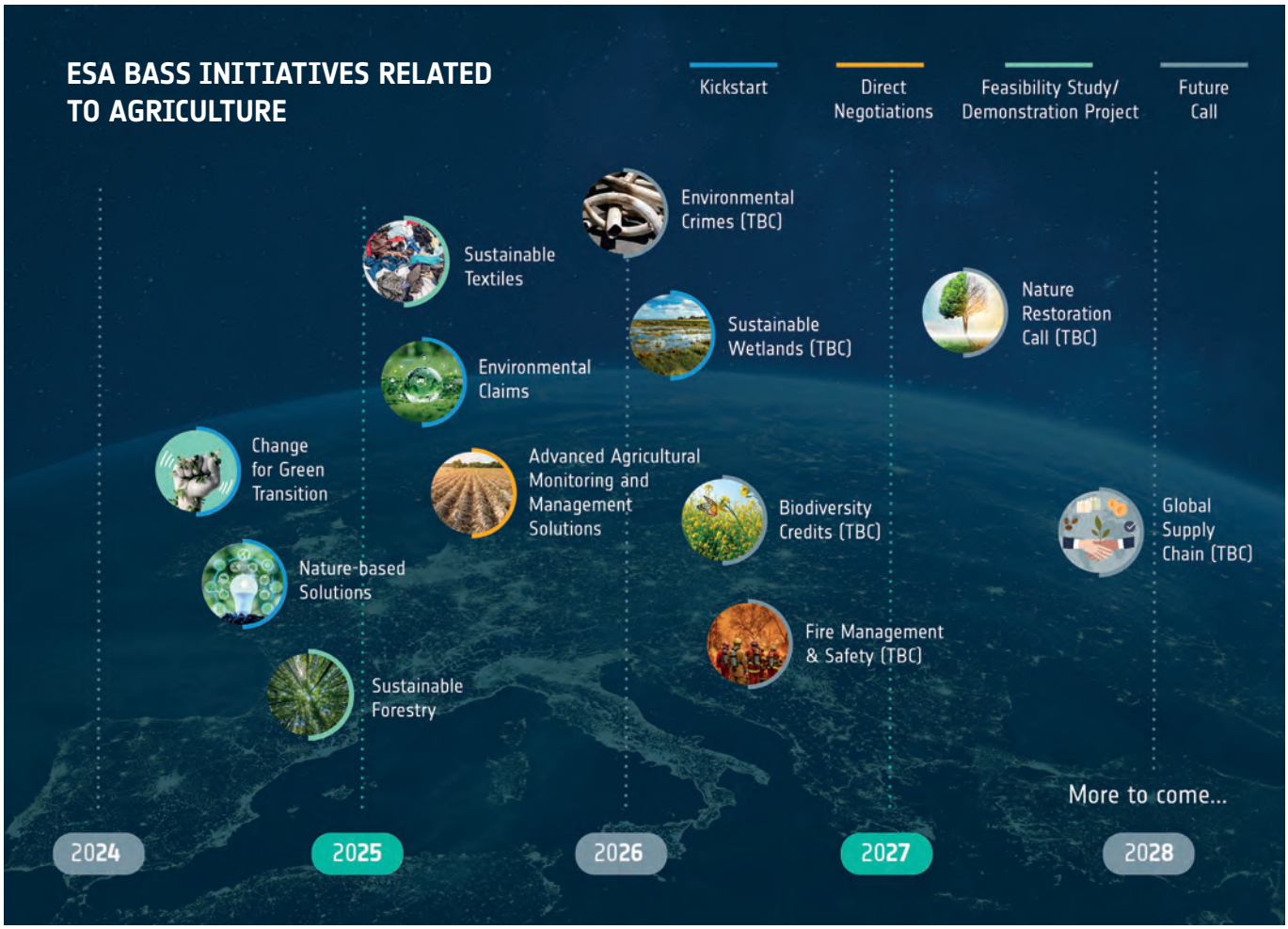
246 Projects
50% being demonstration projects

70% of projects made sales during the pilot phase
compared to **50%** of all BASS projects

80%
SMEs

INITIATIVES

BASS has supported a wide range of initiatives related to agriculture, with many more planned.



THEMATIC AREAS

BASS activities in the agriculture sector fall under four main categories:

Arable Crop Production 90.5M EUR

Solutions focused on optimising crop yields, monitoring soil health and improving irrigation practices. These services enhance productivity, sustainability, and resource management in arable farming.

Forestry and Logging 19.5M EUR

Solutions focused on monitoring forest health, managing timber resources and assessing environmental impact. These services enable sustainable forestry practices, improve resource tracking, and help with compliance for the logging industry.

Fishing and Aquaculture 12.2M EUR

Solutions focused on monitoring marine conditions, tracking fish stocks and improving operational efficiency. These services help ensure sustainable practices and better decision-making in the fishing industry.

Livestock Farming 3.9M EUR

Solutions that aid livestock farming by providing insights into land conditions, animal health and pasture management. These solutions improve productivity, support better resource allocation, and ensure sustainable practices in livestock operations.

PRIORITY INVESTMENT TOPICS

Arable crop production accounts for more than two-thirds of all BASS investment in agriculture and the highest number of Demonstration Projects to date (85), reflecting strong market demand, technological readiness, and the substantial potential for space-enabled solutions to enhance agricultural productivity and sustainability.

Arable crop production encompasses a wide range of topics. The efficient management of arable crop production is crucial, as the threat of climate change has immense implications for our food systems. Ensuring food security, at the same time as promoting sustainable agricultural practices that minimise the environmental impact of farming, continue to be fundamental concerns for the agricultural sector. As a result, farmers are focusing on modernising their crop production systems and leveraging agri-technology for their farms . This presents numerous opportunities for the integration of satellite data and space assets, alongside other digital solutions.

Topics in this category include:

Precision Agriculture

Solutions focused on utilising advanced technologies such as IoT sensors, weather stations and data analytics to optimise farming practices. These services enhance crop management, reduce waste and increase yield efficiency through targeted interventions.

Food Supply Chain & Traceability

Solutions aimed at ensuring the transparency and integrity of food supply chains. These services enable real-time tracking, improving food safety, reducing waste and promoting accountability from farm to table.

Carbon Smart Farming

Solutions focused on capturing and storing carbon emissions through arable farming to mitigate climate change. These services help industries reduce their carbon footprint, promote environmental sustainability and contribute to carbon neutrality efforts.

Ecosystem Preservation

Solutions dedicated to promoting long-term environmental health by reducing resource consumption, minimising waste and ensuring ecological balance. These services support industries in implementing sustainable practices that align with environmental goals.

Farm Management

Solutions that enhance operational efficiency in farming through data-driven insights, resource optimisation and workflow management. These services support farmers in decision-making, ensuring higher productivity and profitability while maintaining sustainable practices.

Pests, Diseases and Natural Disasters

Solutions focused on monitoring and managing the impact of pests, diseases and natural disasters on agricultural productivity. These services provide early warning systems, risk assessment tools, and prevention strategies to protect crops.

BIOECONOMY TASK FORCE

The establishment of partnerships has been a key driver in the success of BASS in the agricultural sector. In 2024, ESA BASS established the Bioeconomy Task Force, bringing together a wide range of organisations with specific expertise around agriculture and related environmental issues. The key aims of the Task Force is to provide use cases for funding opportunities, promote a sustainable green economy through the use of space technologies and amplify the impact and reach of agricultural innovations developed under the programme.

These collaborations play a fundamental role in providing valuable insights that underpin the launch of initiatives and lay the groundwork for future widescale adoption.

BASS has been working with ICT-AGRI-FOOD and Copa-Cogeca for many years on agriculture-related topics. Both have signed a Memorandum of Intent with ESA with the aim of supporting a digital transformation of the agri-forestry sector, promoting innovation while ensuring fair and equal conditions for the farmers. This principle has been respected in several initiatives co-created with the partners such as Sustainable Transformation of Agriculture Through Digitalisation and Space, Sustainable Synergies: Interconnected Systems for Positive Impact and Connected Agriculture.

IMPACT – CASE STUDIES

BASS projects are already having an impact on agriculture across Europe and beyond. These examples demonstrate the breadth and scope of the innovation supported by ESA.

FOOD PRODUCTION

Project name: HARVIC Essential **Country:** France **Investment:** 560K EUR

Offer: HARVIC provides actionable information on crop growth development, quality monitoring and early forecasting of potato yield, with a direct data connection to the customer environment.

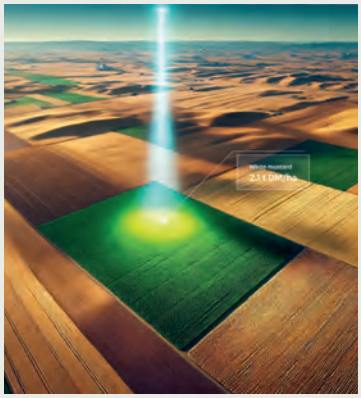
The system offers weekly updates on the quality and vitality development of potato fields to companies in the potato value chain.

Impact:

- Improved supply chain management
- Optimised field operations

BIODIVERSITY PRESERVATION

Project name: MyEasyBiomass **Country:** Netherlands **Investment:** 609K EUR



Offer

MyEasyBiomass offers precise and reliable soil carbon storage calculations, and has the ability to process thousands of hectares in minutes. It is capable of producing biomass assessments even at intra-field levels, quantifying the biomass of cover crops before they are destroyed. It is able to estimate the cover crop biomass at any stage.

Impact

- Farmers are able to trade around 10% more of carbon credits

AGRICULTURAL INSURANCE

Project name: Sat4Insur **Country:** France **Investment:** 270K EUR

Offer

Sat4Insur offers SaaS (Software as a Service) for crop insurance companies. It helps clients in the agriculture sector better evaluate crop yield and the financial impact of adverse weather events, both extreme and recurring, such as drought, excess water and storms.

Impact

- Insurance companies have reliable data to mitigate their own exposure to volatile risks to global food chains
- Meeting a need in the crop insurance market

CAPACITY BUILDING

Project name: Alizeti **Country:** Germany **Investment:** 400K EUR

Offer

Alizeti is a crop monitoring platform developed for smallholder farmers growing high-value crops. It improves the visibility and traceability of both quantity and quality of raw products expected by agri-processors.

Impact

- Agri-processors can better plan their logistics and supply chain
- Smallholder farmers receive valuable data around weather forecasts, agricultural advice, personalised pest warnings and price indications for their harvest

REGULATORY COMPLIANCE

Project name: DROMAS **Country:** Czech Republic **Investment:** 440K EUR

Offer

DROMAS provides precise and actionable data to optimise farming practices for farmers, agricultural advisors and national paying agencies. It helps optimise the use of resources such as water, fertilisers and pesticides to support precision farming.

Impact

- Reduction in labour-intensive high-cost field inspections
- Automation of agricultural subsidy checks

WATER SAVING

Project name: EOLO **Country:** Italy **Investment:** 670K EUR

Offer

EOLO is an automated irrigation service for agronomists and corn growers which aims to reduce the amount of water they need to use for crop cultivation, offering a forecast which exploits vegetation indexes from EO data to help monitor crop health.

Impact

- 16% water savings in corn production
- No impact on yield

ETHICAL FOOD PRODUCTION

Project name: ORCAS **Country:** UK **Investment:** 560K EUR

Offer

ORCAS Is a peer-to-peer marketplace for coffee and other commodity trading. It uses a blockchain-based platform to guarantee provenance of coffee, offering classification and prediction of coffee yield. It also provides transparency along the entire supply chain.

Impact

- Importers can demonstrate the sustainable origins of their product
- Small producers can evidence compliance with sustainability regulations
- To date it has protected >1,000,000 family incomes

CARBON FARMING ASSISTANT

Project name: SOCMo 4 RegAg **Country:** Netherlands **Investment:** 820K EUR

Offer

SOCMo 4 RegAg improves carbon sequestration and storage in the soil and provides a comprehensive view of soil health. Delivering near real-time results, it tracks changes over time and empowers stakeholders to make data-driven decisions for sustainable land use and soil health.

Impact

- Up to 80% improved accuracy
- Enhances productivity and sustainability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GROWTH PROJECTS

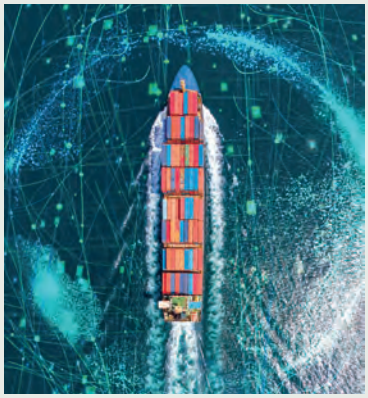
There is a growing interconnection between agriculture and other sectors, driven by shared challenges such as climate change, resource efficiency, and technological innovation. Furthermore, evolving regulatory frameworks increasingly address cross-cutting issues—such as environmental sustainability, digital transformation and carbon reduction—encouraging initiatives that, while not exclusively agricultural, contribute to innovation and improved practices in the sector.

Growth projects are a new category of BASS projects with the potential to expand into adjacent markets, grow their business and scale at speed. They will facilitate the evolution of solutions which have all the prerequisites for expanding towards new market opportunities. Companies will be provided with additional tools including financial support, access to investor networks, and business multipliers, which will enhance the socio-economic impact of the project by targeting a bigger customer base.

Examples include:

WATER SHARING

Project name: Hidromod **Country:** Portugal



Current

Aquafarm integrates data from satellites with meteorological models and measurements as well as plant growth models to provide results about plants and soil.

It helps farmers and water managers ensure efficient and sustainable use of water in agriculture.

It also helps governments verify CAP payments.

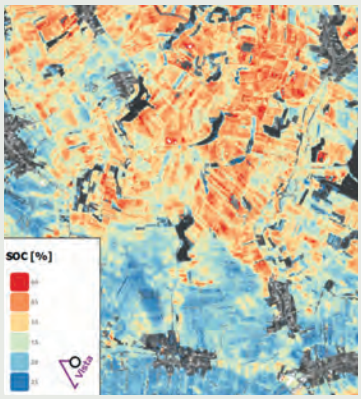
Potential Growth

The company is evolving this technology to serve the maritime / offshore markets, launching a set of services delivered worldwide to both markets, which offer:

- improved safety at sea
- better regulatory compliance
- improved offshore energy planning

FOOD PRODUCTION

Project name: DigiFarm **Country:** Norway



Current

Platform to provide field boundaries and seeded acres for in-season crop-field analysis, helping farmers optimise their resources and increase yield.

Potential Growth

The company is planning to expand services targeting regenerative agricultural practices to:

- serve the needs of banks and insurances
- wide number of crops
- expand to new countries

CARBON REDUCTION

Project name: Vista GmbH **Country:** Germany

Current

This is a monitoring, reporting and verification (MRV) service based on satellite information and field data.

It helps assess soil organic carbon content, carbon stock in soil and plant, catch crop detection and proof of crop rotation.

Potential Growth

The company is planning a water-energy-food nexus digital twin which will expand the offering to:

- smart farming practices
- ecosystem preservation
- climate change impact mitigation measures

FUTURE PLANS

In line with ESA's Strategy 2040, agriculture remains a priority topic for BASS, with work ongoing to protect our planet and climate, strengthen European autonomy and resilience, and boost growth and competitiveness.

Future focus will be on four main areas:

- Conservation and restoration of biodiversity
- The impact of the global value chain of commodities on agriculture
- Enhancing the resilience of the agri-food sector
- Responsible use of fresh water

CONCLUSION

The growing threats of climate change, soil erosion and biodiversity loss have made farming more complex. New approaches and technologies can support farmers and the agricultural industry to adapt to these changing economic, ecological and social factors. Satellite and innovative technologies have the potential to revolutionise agriculture practices, offering new tools to enhance efficiency, monitor environmental impacts and improve resilience, with BASS at the forefront of that transition in Europe.

The added value that space can bring to the agricultural sector is well recognised by industry and end users. BASS continues to support ground-breaking innovation in Europe with a global impact.

Find out more about ESA's work on the Bioeconomy on our website.

Sign up for our quarterly Bioeconomy Bulletin

business.esa.int

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