Digital Jersey Technology Roadmap Sector: Agriculture

DIGITAL JERSEY

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CHAPTER 1: THE STATE OF THE ISLAND

JERSEY'S UNIQUE STRENGTHS

Jersey produces globally recognised products that are renowned for their quality, provenance and traditional farming techniques. There is a great opportunity to become recognised as a leader in agricultural technology and a go-to location for tech providers and innovators.

SCALE AND IMPACT

The small geographical scale and close-knit farming community presents an excellent proving ground for joined-up development of technology opportunities. Jersey offers a perfect location for tech providers to develop and test their products, allowing the island to be at the forefront of farming innovation.

LOCAL EXPERTISE

Jersey boasts a community of skilled and innovative farmers who have a deep understanding of the land and its resources. This expertise has been passed down through generations, ensuring the continued production of high-quality agricultural products.

POLITICS

A relatively small political hierarchy and financial support structure enables more rapid change and investment, where the voices of the farming community can be heard as individuals and through industry groups.

JERSEY'S BIGGEST CHALLENGES IN AGRICULTURE

LAND MANAGEMENT AND SOIL HEALTH

Jersey is a small island with limited land available for agriculture. This presents several challenges and difficulty in the adoption of traditional land management practices, such as crop rotations. A high proportion of rented land can also be a barrier to long-term investment in some aspects of land management, including the knowledge of field history needed to make crop management decisions.

RESOURCE AVAILABILITY AND CLIMATE

Whilst the varied soil type across the island and mild climate can present opportunities for early cropping, resources such as water availability can be a challenge during summer months. Less reliable and more extreme weather patterns create difficulties with efficiency planning, crop performance predictions and slurry management.

ENVIRONMENTAL IMPACT

Farming practices can have an impact on the environment, particularly on soil health and water quality. Whilst there are many positive aspects to farming, the use of fertilisers, pesticides and slurry contribute to local environmental concerns such as ground water contamination and wider impacts such as greenhouse gas emissions.

RISING COSTS

The costs of energy, labour and inputs are on the rise and increase pressure on profit margins. It is essential to find ways to increase efficiency and reduce costs to maintain the economic viability of farming.

COMPETITION

Jersey's agricultural products face competition from other regions and countries. To stay ahead in the global market, it is vital to maintain the high quality of Jersey's produce and to innovate. This includes exploring new technologies and farming practices that can enhance productivity and sustainability.

LOCAL SUPPLY AND FOOD SECURITY

The cost of production in Jersey can be a barrier for wider scale supply of local produce. Larger retails can favour the cheaper prices and simplified supply chains of off-island produce, which leaves Jersey reliant on imports. This presents an issue of food security at times of extended poor weather or other crisis, but also a missed opportunity for farmers to sell produce directly to the local community.

DATA SHARING

The use and sharing of data underpins many of the technology opportunities detailed in this document, particularly the drive towards a more precision-based approach. Data can support farmers existing knowledge and skills by exposing the relationships between the environment, inputs and their product quality and yields. Data sharing among farmers and researchers facilitates the development of new agricultural technologies and best practices, fostering innovation and sustainability in the agricultural sector.

BARRIERS TO THE ADOPTION OF TECHNOLOGY

Digital Jersey aims to support the industry with the challenges associated with adoption of technology, including the initial choices, proof-of-concept trials and the training and skills required to use new technology confidently and independently.

RETURN ON INVESTMENT (ROI)

Narrow profit margins and seasonal variation in costs and returns can mean farmers are hesitant to invest in technology without a clearly defined and proven ROI. These metrics will be clearly determined in the trail phase of projects, facilitating strong business cases and applications for funding where necessary.

LACK OF INFRASTRUCTURE

Many technology solutions require infrastructure such as internet connections and other networks, such as LoRaWAN. Digital Jersey will provide the connections and specialist expertise to build and develop infrastructure requirements to deliver successful projects.

TRAINING AND SUPPORT

Access will be available to resources and courses allowing technology users to learn and develop the operating skills needed to engrain technology in their business. Where necessary, this also includes training to meet regulatory requirements, such as drone operator licences.

CHOICES AND EMERGING TECHNOLOGY

A number of different options are often available, that deliver a similar service or solution. It can be difficult to determine which solution is best suited to a particular business or problem. This can be the case particularly at early technology development stages, where a concept is yet to be proven. Financial and technical support will allow informed choices and advice with little financial risk, until the technology is tailored or developed to a fully working model.

ENVIRONMENTAL VARIABILITY

Due to the nature of farming, with multiple and variable environmental inputs it can be difficult to determine the efficacy of technology in isolation. Jersey also has specific climates and conditions that require careful consideration, which is why a proof-of-concept trial approach is important to demonstrate confidence in new technology.

INTEGRATION WITH TRADITIONAL FARMING

The need to maintain traditional farming practices are important for the Jersey Royal Potato brand and its associated protected designation of origin status. It remains important for technology to supplement traditional farming without detracting from important traditional techniques and principles.

LOOKING AHEAD, WHERE COULD WE GO?

The future of Jersey's agriculture lies in its ability to adapt and innovate. By embracing new technologies and sustainable practices, the sector can address the challenges it faces while maintaining the high quality and status of its products.

The Jersey Agricultural Technology Hub Roadmap outlines a vision for the future of farming on the island. It focuses on key areas such as soil health, data and sharing, energy and emissions, automation, and biotechnology. By embracing the opportunities in these areas, Jersey can ensure that its agricultural sector remains vibrant and competitive in the years to come.

The roadmap also emphasises the importance of collaboration and knowledge sharing. By bringing together farmers, researchers, and technology providers, Jersey can foster an environment of innovation and growth.

CHAPTER 2: TECHNOLOGY ROADMAP FOR THE FUTURE

This technology roadmap for agriculture is built upon three fundamental pillars: Research, Empower, and Promote. This three-pronged approach is crucial because it allows us to address the multifaceted challenges and opportunities facing the agricultural sector in a holistic manner, as well as providing opportunties to address the barriers and issues in a stepped and progressive way.

Research

Timescale for adoption
3-5 years

This section of the roadmap will explore how cutting-edge technologies like gene editing, artificial intelligence and advanced imaging techniques can be harnessed to accelerate agricultural research and drive innovation. These are based on emerging technologies and where the principles already exist, but are not yet applied in a commercial agricultural setting. Development of these technologies will not only uncover new possibilities for improving crop yields and resilience but also help us develop sustainable farming practices that protect our planet into the long-term.

RESEARCH PROJECT OPPORTUNITIES

1. Quantifying Potato Cyst Nematodes using Artificial Intelligence

Island Problem
Land management and soil health

Detailed Problem
Potato cyst nematodes have become a key pest of potato crops. With no chemical controls available or the ability to grow resistant varieties, the issue must be tackled culturally. Current soil analysis protocols for potato cyst nematodes are costly and labour intensive, which limits the data potential and precision due to sample aggregation. Effective soil analysis for potato cyst nematodes (PCN) is crucial for land management and crop protection, but current methods are specialised, costly and labour-intensive. Limiting data scope and precision management adoption due to cost-saving measures like aggregating samples.

Proposed Solution
Develop an AI tool to detect and quantify PCN cysts and juveniles, cutting costs and time, thus enabling higher volume analysis, which enhances data resolution across agricultural land and aids in the shift toward precision management.

2. Stabilising and enriching slurry with plasma

Island Problem
Environmental impact

Detailed Problem
Dairy farming produces a number of gasses from the digestion and slurry produced by livestock. Nitrogen-rich slurry is routinely spread on fields which benefits microbial health and crop nutrition. However, emissions can include ammonia and nitrous oxide both of which are many times more potent greenhouse gasses than carbon dioxide. Furthermore, both gasses contain nitrogen which is lost to the atmosphere rather than being incorporated into soils and available for future crops. Since slurry and emissions are an inherent part of raising cattle, optimised slurry management has the greatest impact on environmental impact of dairy farming.

Proposed Solution
Investigate and work with an existing system that fixes nitrogen from the air using plasma, which is used to enrich and stabilise slurry. This increases the amount of available nitrogen to crops as well as preventing production of ammonia and loss of gaseous nitrogen. The smell associated with slurry spreading is also reduced. The technique may also reduce the leaching of nitrogen into ground water, which is a significant problem in Jersey.

3. Electronic and Driverless Tractors

Island Problem
Environmental impact

Detailed Problem
Fuel prices contribute significantly to the operational cost of farming. Electric tractors have until recently been limited to small compact models, which can be ideal for low-power operations on Jersey's smaller fields. Nonetheless, mainstream manufacturers such as Case and New Holand T4 now offer larger models and outputs equivalent to 75hp. The use of conventional diesel tractors also contribute to a farms carbon emissions, particularly on a local level. Compared to diesel tractors, electric tractors can be more energy-efficient and, when charged with renewable sources of power generation, have a significantly lower overall environmental impact.

Proposed Solution
Broker a demonstration model and visit of an electronic tractor manufacturer to Jersey, in order to increase industry engagement and awareness of the current status and opportunities of electric farm vehicles.

4. Asses the Feasibility of a Robotic System for Potato Seed Standing and Planting

Island Problem
Rising costs

Detailed Problem
The agricultural industry, especially in cultivating Jersey Royal potatoes, faces growing challenges due to rising labor costs and a shortage of skilled workers, requiring seed planting and standing by hand. However, the potential for robotic solutions has not been thoroughly explored. Currently, these solutions are seen as too costly and technically complex for practical use in Jersey.

Proposed Solution
Build the connects between a robotics provider and the Jersey farming industry, with a view of assessing the feasibility of developing a robotic system for seed standing and planting.

5. Gene Editing

Island Problem:
Competition

Detailed Problem
Gene editing of crops in the UK and Jersey presents a critical opportunity to address several pressing agricultural challenges, including food security, climate resilience and crop protection sustainability. With growing demand for food, rising input costs and increasingly unpredictable weather patterns due to climate change, traditional crop breeding methods are struggling to keep pace. Gene editing offers the potential to develop more resistant crops that requiring fewer resources such as water, fertilisers and pesticides. Additionally, it can accelerate the development of higher-yielding, more nutritious crops, alleviating pressures on land use and lowering the environmental impact of farming. Embracing gene editing is also important for Jersey to maintain a competitive agricultural sector, reduce its carbon footprint and ensure a stable, resilient food supply for the future.

Proposed Solution
Gene editing technology has made significant regulatory and scientific progress in recent years and is currently at a stage where it is more precise and efficient than traditional genetic modification techniques. CRISPR allows scientists to make targeted changes to a plant's genetics, that is essentially accelerating a natural breeding and selection process. The Genetic Technology (Precision Breeding) Act 2023 sets out the regulatory distinction between gene edited crops and those genetically modified, paving the way for the development and marketing of gene edited crops in the UK. Nonetheless, gene editing is at an early stage and will likely take several years to reach commercial scale crops. The process is also likely to begin with relatively simple genetic changes, with more complex multi-faceted issues taking much longer. It is important that Jersey establishes a joined-up approach for gene editing together with a strategy that keeps up with development and public acceptance of this technology.

6. FarmBot

Island Problem:
Rising costs

Detailed Problem
Attracting young people to agriculture in the UK is becoming increasingly difficult as the sector is often perceived as traditional, labour-intensive and lacking innovation. However, integrating modern technology into farming presents an opportunity to reshape these perceptions and engage a younger more tech-savvy generation. The challenge lies in demonstrating how technology can make agriculture more efficient, data-driven and environmentally sustainable, offering exciting career paths that align with the interests of today's youth. Bridging this gap requires hands-on tangible experiences demonstrating the industries potential to solve global challenges like food security and climate change, while providing fulfilling, future-focused careers.

Proposed Solution
FarmBot is a computer-controlled system that allows remote crop inputs using a boom within a fixed frame, build around the cropped area of ground. Described as 'CNC farming,' the system can deliver a number of inputs including seed drilling, irrigation and harvest using a variety of different attachments. This project aims to run a proof-of-concept trail of the system to asses the potential for the system to be scaled up for commercial purposes as well as providing the opportunity as an educational tool to engage and attract young people into farming and technology. The project also aims to combine specialist solar panels from PolySolar that will power the FarmBot system, further enhancing the systems environmental credentials and engagement with young people.

Empower

Timescale for adoption
1-3 years

Technology holds immense power to empower farmers and agricultural businesses, providing them with the tools and information they need to thrive in an increasingly complex and competitive world. This section of the roadmap focuses on ensuring that technological advancements are accessible and beneficial to all farmers regardless of their scale. We will delve into the development of user-friendly decision support tools that provide farmers with real-time insights on crop health, weather patterns and best practices. This includes exploring the potential of mobile applications, precision agriculture platforms, and AI-powered advisory systems to help farmers make informed decisions and optimise their operations. Additionally, we will examine how automation and robotics can help address labor shortages, reduce the labour demands of farming, and improve overall efficiency.

EMPOWERMENT PROJECT OPPORTUNITIES

7. Quantify Soil Health and Nutrition using in-field Analysis

Island Problem
Land management and soil health

Detailed Problem
Biological health is a fundamental basis for sustainable crop production, yield, quality and operational ability of the soil. However, due to analytical costs and complex interpretation, it is underutilised as a metric despite an increasing focus within farm audit standards, such as Red Tractor and LEAF. Much like PCN soil testing, the process is expensive and time consuming which can inhibit optimal levels of sampling density and testing frequencies. Currently, nutrition and soil health metrics are quantified though a third-party laboratory. Alternative in-house analytical equipment would be more efficient from both a cost per sample as well as processing and reporting time.

Proposed Solution
Trial the use newly available technology, that allows in-field and real time analysis of soil health metrics without the need for off-island analysis.

8. Monitoring Soil Moisture and Climate using In-Field IoT Sensors

Island Problem
Resource availability and climate

Detailed Problem
Efficient water management is vital for potatoes due to their sensitivity to water levels, with optimal irrigation being crucial for yield and quality, particularly during early tuber initiation and near harvest. Current manual irrigation practices lead to wastage and increased disease risk as well as inefficient use of a sensitive resource. The progression towards precision farming and robust analytics also requires the collection of other environmental data sets, including soil temperature and light intensity.

Proposed Solution
Establish a network of IoT sensors to provide real-time data to farmers remotely, so that input decisions can be better prioritised, applied more accurately and more time efficiently.

9. Quantifying Crop Performance with Drone Multi-Spec Imagery

Island Problem
Resource availability and climate

Detailed Problem
Assessment of crop performance is currently based on total yield, marketable yield and visual assessments per field. This provides very little resolution and real-time data that facilitates improved crop management or precision input decisions during the life of the crop.

Proposed Solution
Provide information and support to a grower to choose, operate and interpret a drone-based multispectral system to support their progress towards precision agriculture.

10. Centralised Land Management Database

Island Problem
Data & sharing

Detailed Problem
The absence of a centralised database for the island's land resources hinders efficient collaboration, access to historical data for agriculture and Government decision-making. It also precludes the potential for shared data analytics that would benefit multiple users.

Proposed Solution
Once a data trust structure has been developed, use agriculture as the first industry to input and bring together a number of data streams, to provide a location for new datasets as well as analytical solutions that provides new insights and benefits for all users. Include all data requirements of the single area payment, so that applications can be automated.

Promote

Timescale for adoption
1-2 years

This section of the roadmap focuses on promoting readily available technology to farmers to enhance their operations and profitability. While many farmers are aware of some of these technologies, adoption rates vary. This section provides proof-of-concept trials and guidance on how to effectively implement tools like drone technology and AI herd management. We will demonstrate the efficacy and quantifiable return on investment these technologies to minimise the risk of adoption. By promoting the use of existing technologies, we aim to equip farmers with the tools they need to increase efficiency, reduce costs and improve their overall bottom line.

PROMOTION PROJECT OPPORTUNITIES

11. Mapping of Potato Harvest Yields using Load Cells and GPS

Island Problem
Data & sharing

Detailed Problem
Current crop management does not capture yield variation across each field, which is a barrier to the detail needed to make precision remedial actions to the growing crop or land management process which would support improved crop uniformity and overall efficiency of land use.

Proposed Solution
Trial the use of existing yield monitoring load cells, AI cameras and GPS integration to quantify both weight and count as potato harvesting which provides real-time data and field heat maps of crop performance.

12. AI Herd Management

Island Problem
Data & sharing

Detailed Problem
Traditional herd management relies heavily on manual labour, which can be inefficient and expensive. Monitoring of herds using cameras integrated to AI and ML models enables human staff to focus on strategic and value adding tasks that cannot be automated. AI and ML systems can also assess herds more quickly and continuously than is possible by humans, therefore detecting abnormalities more quickly and accurately. Breeding programmes and genetic tracking and performance can also be monitored.

Proposed Solution
Engage with system providers and industry to assess the suitability of existing options. Support the trial set up and operation for one dairy farm, together with documented case study and review of potential expansion across the dairy sector.

13. Develop Photovoltaic Energy Solutions for Protected Cropping Systems

Island Problem
Local supply and food security

Detailed Problem
Crop production under glass or polytunnels allows production of salads, early potatoes and other crops or plugs in a controlled environment, protected from adverse weather. Typically, glasshouse crops in Jersey are heated through the winter months using oil which has become increasingly expensive and unsustainable. Historically, these costs have led to a significant decline in UK protected crops with the majority now imported from Southern Europe where heating and light are not required. Latest developments in photovoltaic panels allows retrofitting to existing glass and plastic structures, which may provide a cost-effective solution for providing electricity. These solutions are becoming integrated into wider technology use, such as robotics, but may also pave the way for low-emission electrical heating systems.

Proposed Solution
Trial two solar panel solutions, a poly tunnel and glass house, to assess energy capture, crop performance and cost effectiveness. Use the data to assess viability scale-up and investment of electrically powered heating solutions.

14. Drone Crop Spraying

Island Problem
Rising costs

Detailed Problem
Crop spraying is a full-time task for one, if not more, highly skilled operator depending on the size of the farm. Potatoes require continuous pre-emptive applications of fungicide to minimise the infection risk from blight. Blight risk is very weather dependant and increases rapidly if spray intervals are missed or extended, therefore an ability to respond rapidly is essential to protect valuable crops. Blight can quickly take hold and decimate entire fields if left uncontrolled, further increasing risk to neighbouring crops. A proportion of Jersey crops are grown on steep and are inaccessible côtils, in which crops must be treated manually with associated health and safety risks that could be avoided with overhead drone application.

Proposed Solution
Purchase, trial and showcase the use of an existing drone spraying system, to increase the speed and efficiency of spraying operations as well as reduce health and safety risks of inaccessible fields.

CHAPTER 3: MAKING IT HAPPEN

This roadmap has outlined the potential for technology to support the improved efficiency and sustainability of Jersey's agricultural sector. For technology adoption and use to become an engrained feature of the industry and not just a series of ideas, there needs to be a foundation of investment and mechanisms that support sustained delivery.

INVESTING IN THE FUTURE

FUNDING

Transforming Jersey's agricultural landscape through technology requires significant investment. A multi-faceted funding approach will be essential, drawing on a combination of:

- Existing Government funding streams through the Rural Support Scheme can be used effectively for individual projects, or across a group where there are shared benefits. Other proven island initiatives, such as LoRaWAN networks can also be piggy-backed and adapted to benefit the agricultural industry without the investment costs associated with setting up from scratch.
- Private investment must be encouraged, from companies who benefit indirectly from increased efficiency of their supply base or from the provider of technologies that may benefit from future scale and investment from the industry.
- Research Grants: Actively pursue research grants from national and international organisations to support the development and testing of new technologies specifically tailored to Jersey's unique agricultural environment.
- Agricultural Loans Scheme: The soon-to-be-launched revised loan scheme is designed to facilitate investment in agricultural equipment and technology.

SKILLS

Technology is only as good as the people who use it. Equipping Jersey's farmers with the necessary skills to utilise these advancements is paramount. This can be achieved through:

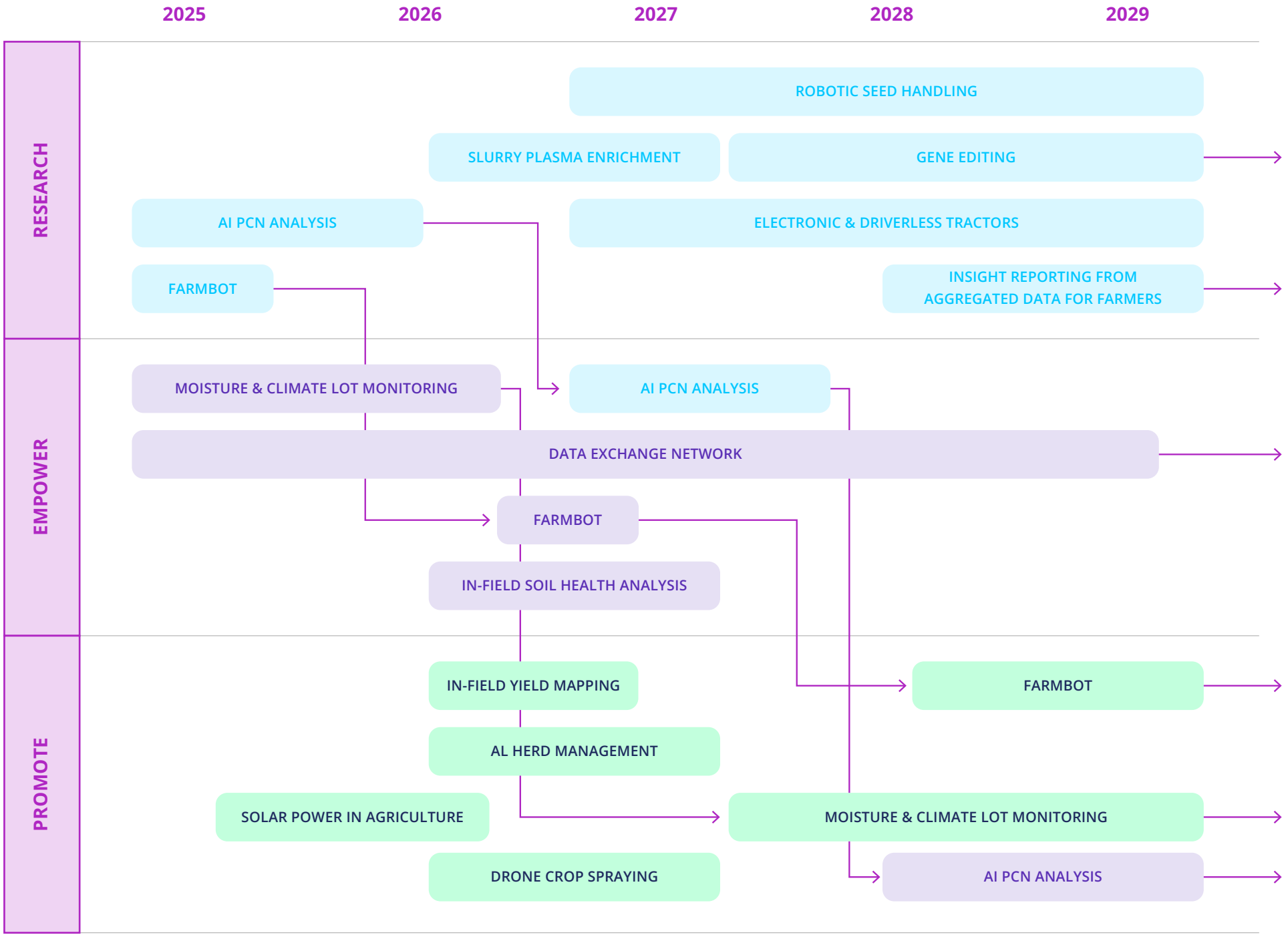
- Training Programs: the ability to use technology should be in the hands of farmers and minimise reliance on services from third parties. Accessible and affordable training from technology experts and providers is at the heart of successful and sustained adoption.
- Knowledge Transfer: Trial programmes will train and equip individual farmers with experience and skills. These learnings and knowledge can then be shared with other farmers in their network. The more connected their operations and data are shared, the more potential there is for everyone.
- Off-Island Relationships: Build relationships with agricultural technology groups and institutions in the UK, France and elsewhere to share opportunities and experience in other jurisdictions and farming settings.
- Succession and Education: Partner with local schools and educational institutions to integrate real-world AgriTech demonstrations and engagement with existing education curriculums for young people. Combining STEM skills with applied agriculture helps to equip the next generation with the enthusiasm and interest to pursue a career in farming.

WORKING TOGETHER

The scale and intimate nature of Jersey's agricultural industry is ideal for collaboration and a shared approach that benefits all farmers, the wider community and the environment. Although farming groups of dairy and potatoes are well established, more can be done to build a shared culture and accelerate progress.

- Demonstration Farms: Create demonstration farms showcasing the successful implementation of various technologies. These farms can serve as learning centres for other farmers and host workshops and field days.
- Open Data Platforms: Develop platforms for sharing agricultural data, allowing farmers to benchmark their performance, identify trends, and make informed decisions.

Agritech Roadmap



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