MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

EVIDENCE & INSIGHTS BRANCH

A definition and taxonomy for monitoring the Aotearoa New Zealand agritech sector

New Zealand Government

Contents

Introduction: a clear definition and taxonomy of subsectors will help us measure the agritech industry

The Agritech Industry Transformation Plan (ITP) contributes to the government's vision of a productive, sustainable and inclusive economy by setting out an approach to the long term transformation of the agritech sector. The Ministry of Business, Innovation and Employment (MBIE) is the lead agency for the Agritech ITP and is tasked with improving measurement of the sector.

The Agritech ITP defines agritech but has some 'grey areas' that need clarification if we are to use it to classify firms as in, or not in, the agritech sector. We also need to develop a taxonomy of subsectors within agritech to use in analysing aggregate statistics. The taxonomy should subdivide the sector in a way that is meaningful for New Zealand so that we can better understand the characteristics of the sector and where New Zealand's strengths in agritech lie.

This document sets out a clarification of the grey areas in the Agritech ITP's definition and a taxonomy of agritech subsectors for New Zealand. The clarifications and taxonomy have been developed in close consultation with other organisations, including Agritech New Zealand, Callaghan Innovation, New Zealand Trade and Enterprise, and the Ministry of Primary Industries.

MBIE will use the definition to identify New Zealand agritech firms and the taxonomy to categorise those firms (via a survey of the industry). The survey data will then be linked with official statistics in the Stats NZ Longitudinal Business Database and aggregated (anonymously) to produce an agritech industry monitoring report. While the clarifications and taxonomy are primarily for MBIE's measurement work, other agencies may also choose to use them.

The Agritech ITP's definition is supplemented by 10 clarifications

Agritech firms, as defined by the Agritech ITP

The Agritech ITP defines agritech firms as follows.

> *"Manufacturing, biotech and digital-based technology companies that are creating product, service, IP and value chain solutions for the agriculture, horticulture, aquaculture, apiculture and fishing sectors, with the aim of improving yield, efficiency, profitability, sustainability, reliability, quality or adding any other kind of value. Forestry is excluded because forestry and wood processing is the focus of another dedicated ITP"*

Although forestry technology is not covered by the Agritech ITP, we will be including it in our identification of agritech firms. More information is in the 'Forestry' section below.

Clarifications to supplement the definition

1. Processing of primary products is not agritech.

Although agritech contributes to the wider food and fibre sector, it only relates to solutions for primary producers in agriculture, horticulture, aquaculture, apiculture and fishing. Technologies that help primary producers to improve what they do are classified as agritech, but technologies used by manufacturers to process primary products are not. For example:

a. Food technologies such as canning, pasteurisation and the steps in wine-making from grape crushing onwards are not agritech
b. Wood processing technologies, including lumber yard processes such as sawing and treating wood and the testing of cut lumber are wood processing, not forestry agritech. Technologies that are used in-forest are forestry agritech.

2. Traceability, packing, cooltech and other supply chain solutions for unprocessed primary products are agritech.

Supply chain solutions, including traceability technologies, packing technologies and cooltech, are agritech, where they have an on-farm component or where they're being used for unprocessed primary products. For example:

a. Firms that make fruit or vegetable packing technologies are agritech.
b. Technologies specific to log transport, tracking, and testing, prior to arrival at a lumber yard, are forestry agritech.
c. A packing technology becomes processing, and therefore not agritech, if the product is processed, e.g. canning of fruit and vegetables.

3. Products and services tailored for agricultural use are agritech but generic products and services used by primary producers are not.

Agritech includes products and services that help primary producers improve what they do. But it is restricted to those that address problems that are specific to the agriculture, horticulture, aquaculture, apiculture and fishing industries. For example:

a. Firms producing business software tailored for agricultural use are agritech.
b. Firms producing general business products and services (such as rural internet service providers and generic office software and accounting packages) are not agritech even though their products and services are used by many primary producers.

For some firms, it's difficult to determine whether their products and services are sufficiently tailored to be considered agritech. These firms will be considered on a case-by-case basis, taking into account:

c. whether the product or service is predominantly used by primary producers or by others
d. whether the product or service was developed specifically for primary producers or whether it was developed for other sectors, with agricultural uses identified incidentally.

4. Firms that produce agritech and non-agritech products and services are agritech.

Some firms work in agritech and non-agritech areas, using similar technologies to create agricultural and non-agricultural products and services. These firms are agritech if a significant proportion of their business is agritech (more than ~25%).

5. Providers of services to agriculture are not agritech unless they are creating manufacturing, biotechnology or digital technologies for agriculture.

The definition restricts agritech to manufacturing, biotechnology and digital-based technology companies.

<u>Included in agritech:</u>

a. Firms that focus on providing customised or bespoke manufacturing, biotechnology-based and digital services to primary producers, with the customisation comprising more than ~25% of their business, such as:

- firms that customise existing software for use by primary producers.
- firms producing software tailored for agriculture that is provided as a service.
- providers of drone-based services such as farm mapping.
- providers of customised machinery and engineering solutions, where this customisation is their primary focus or is more than 25% of their business.
- providers of genetic advice to assist breeding programmes.
- providers of technology-based testing services to primary producers including soil and other environmental testing services for primary producers, and pesticide residue and other types of testing of unprocessed primary products.

Excluded from agritech:

b. Service providers that are not technology companies, such as veterinarians, shearers, silage spreaders, haymakers, and other providers of standard services to agriculture.
c. Firms that design, supply, install and service farm machinery manufactured by other firms with limited customisation, e.g. installers or milking, effluent, irrigation and water management systems.
d. Seed propagation and animal breeding companies that are not biotechnology companies. These excluded firms may import genetics and do small or large scale propagation in New Zealand, but if they don't make any modification to genotypes or phenotypes, they are not agritech.
e. Firms that provide advice to primary producers, where this advice is not specifically based on a manufacturing, biological or digital technology. For example, consultancies providing advice on business management, logistics, animal/crop health or mitigation of environmental impacts are classed as standard service providers and not agritech unless their advice is based on, and facilitating access to, a specific agricultural technology.
f. Firms that retail or wholesale other firms' products for agriculture, and do not make any of those products themselves.

6. High and low technology manufactured products for agriculture are agritech

Manufactured products for agriculture range from very high technology items, such as robotics, through to low technology products, such as timber fence posts. There is no clear boundary between high and low technology items and so we categorise all manufactured products for agriculture as agritech.

7. Firms that commercialise agritech R&D are agritech

Firms that hold agritech-relevant intellectual property (IP) and sell or license it are agritech, even if they are not making the products or services that use the IP.

Included in agritech:

a. Firms that are commercialising agritech-relevant R&D, where this comprises more than ~25% of their business.

Excluded from agritech:

b. Firms that are carrying out agricultural research but not commercialising that IP.

8. Supplying technology for another firm's agritech product does not make a firm agritech

Some firms do not themselves produce complete agritech products, but supply components to agritech firms, or provide services to help other firms develop their agritech products. These firms are not agritech.

9. Vertically integrated producers are agritech if their primary focus is on developing new agricultural technologies, but not if they are primarily a producer

Many primary producers develop new technologies for their own use but this does not make them agritech firms. However, some vertically integrated primary producers focus primarily on agritech, with primary production a secondary operation. These firms are classified as agritech based on their current focus. Some may become primary producers instead of agritech firms in future, if their focus shifts towards primary production and away from developing agritech.

10. Products and services for horse breeding and care are not agritech

Unlike most farm animals (e.g. sheep, cattle, pigs), horses are bred primarily for recreation, sport, and racing, not for the creation of primary products. We therefore do not classify horses as agricultural animals and firms producing products and services only for horse breeding and care are not agritech. For example:

a. a firm that manufactures supplements for dogs, cats, and horses (but no other farm animals) is not agritech
b. a firm that manufactures feed for horses and for agricultural animals, such as sheep and cattle, is agritech.

Forestry tech firms will be identified but not included in monitoring of the agritech sector

The Agritech ITP's definition excludes firms that are creating solutions for the forestry industry because they are covered by the Forestry and Wood Processing ITP that the Ministry for Primary Industries is leading. MBIE's agritech monitoring report will also exclude these firms, so as to align with the Agritech ITP's definition.

However, when we identify and survey agritech firms, we will include forestry tech, so that the dataset will be better aligned with international definitions of agritech and will be future-proofed against possible changes to this aspect of New Zealand's agritech definition.

Firms that produce technology for forestry and logging only will be identified by their categorisation in the taxonomy (below).

Wood processing firms will not be included because the processing of primary products is not agritech.

We use a two-axis taxonomy to define agritech sub-sectors by technology type and agricultural use

Our taxonomy for monitoring the New Zealand agritech sector is presented below. Classifying firms according to this taxonomy will allow us to understand:

- what broad types of agricultural technologies New Zealand agritech firms are producing
- what types of agriculture New Zealand agritech firms are predominantly serving.

Types of agricultural technologies

Technology type	Includes:
Digital tools	• Sensors and actuators for any farm, seafood or forestry application including environmental monitoring, plant/animal health or breeding. • Data collection and analytics for agricultural management. • Digital mapping and imagery. • Digital traceability solutions. • Software for agricultural administration, trading and labour management.
Machinery and plant	• Robotics and smart equipment. • Vehicles and vessels. • Mechanised equipment and plants for animal handling, crop handling, or primary product sorting (e.g. milking sheds, cultivators, vegetable packing machinery). • Indoor agriculture systems. • Irrigation and pumps. • Logging machinery. • Parts for agricultural machinery.
Non-mechanised and non-digital equipment	• Farm and livestock handling tools. • Fencing products. • Specialist clothing. • Troughs. • Nets and lines. • Agricultural textiles and cordage. • Packaging products for unprocessed primary products • Non-digital veterinary equipment for livestock, such as bandages, but excluding pharmaceuticals.
Agrichemicals, pharmaceuticals and nutrition	• Fertilisers. • Pesticides. • Chemicals for water and effluent treatment. • Other agrichemicals. • Animal feed and supplements. • Veterinary pharmaceuticals for livestock.
New varieties and breeding services	• New or modified animal and plant varieties. • Genetic testing and evaluation services • Excluding digital tools, machinery or equipment for plant or animal breeding.
Agricultural testing and technological advice	• Testing services for agriculture (e.g. soil testing, testing of unprocessed primary products, environmental testing). • Technology-based advice for agriculture, not covered by other categories. • Excluding genetic testing and evaluation services (which are 'new varieties and breeding services'). • Excluding digital mapping and imagery services and software provided as a service (which are 'digital tools').

Surveyed firms will be asked what types of agricultural technologies they produce. They will be asked to select as many of the above categories as are applicable and then to select just the main one (the area that accounts for most of their agritech revenue).

Types of agricultural uses

Agricultural use	Includes:
Horticulture	Cultivation of fruits (including viticulture), nuts, vegetables, mushrooms and grains.
Animal and pasture farming	Apiculture and the farming of sheep, beef, dairy, pigs, deer, poultry and other animals.
Aquaculture and fishing	Onshore and offshore aquaculture, lobster and crab potting, prawn fishing, line fishing, fish trawling, seining and netting, and other types of fishing.
Forestry and logging	Forest planting, forest management and maintenance, timber harvesting.

These categories are based on ANZSIC codes.

Surveyed firms will be asked what types of agriculture their products or services are used for. They may select as many categories as apply.

Other survey questions will ask about the proportion of firm activity that is agritech, sustainability, and skills

In addition to the taxonomy-based questions, the survey will:

a. ask for confirmation that firms fit the agritech definition (the survey will conclude if they don't)
b. ask what proportions of revenue, exports, and employment are attributable to agritech, in broad bands, e.g. 0%, 1-25%, 26-50%, 51-75%, 76-100%
c. ask if the firms' agritech products or services aim to reduce any of agriculture's negative environmental impacts
d. seek permission to confidentially link survey responses to data in the secure Stats NZ datalab environment
e. ask if the firm is willing to be contacted for a future survey on skill needs and gaps.

The clarifications and taxonomy were developed by reviewing other taxonomies, consultation, and testing

Clarification of the agritech definition and development of the taxonomy involved the following steps.

- A review of existing international and New Zealand agritech taxonomies, including those used by New Zealand Trade and Enterprise, Callaghan Innovation, Finistere Ventures, AgFunder, and a University of Sydney report on Australian AgTech (Appendix 1).
- Consultation with members of the Agritech ITP taskforce, including representation from MBIE, New Zealand Trade and Enterprise, Callaghan Innovation, and the Ministry of Primary Industries.
- Consultation with Agritech NZ.
- Addition of definition clarifications to address ambiguities that were found when identifying agritech firms.
- Testing the taxonomy, by using it to classify a sample of known agritech firms, looking for ambiguities and gaps in the categories.

An initial draft taxonomy was developed based on the taxonomy used in a 2018 University of Sydney report on Australian agritech.[1] However testing and consultation revealed redundancies and gaps in this taxonomy that made it a poor fit with the New Zealand agritech sector. None of the other existing taxonomies provided a better fit (Appendix 1) so we developed the new taxonomy in this document for the purpose of monitoring the New Zealand agritech sector.

International comparisons will be limited but our method provides a reproducible way to track agritech performance over time

Appendix 1 outlines the similarities and differences between our taxonomy and the other taxonomies that we have reviewed. While our taxonomy has similarities with an Israeli one, comparisons between our findings and overseas reports will not be valid because the overseas reports focus on investment-ready start-ups, while our work includes all New Zealand agritech firms, regardless of maturity or potential for growth.

While our ability to make international comparisons will be limited, this approach provides a reproducible method to assess the trajectory of New Zealand's whole agritech sector, over time, in a way that will inform work on the Agritech ITP.

Our next step is to survey firms, using the definition to identify agritech firms and the taxonomy to categorise them

MBIE has used the agritech definition and clarifications to the definition to identify a set of New Zealand firms that are potentially within the agritech sector. The next step will be to survey those firms to:

- confirm whether or not they are in the agritech sector
- assign them to areas of the taxonomy
- ask about firm revenue, exports, employment, and environmental impact mitigation.

The survey data will then be linked with other data on New Zealand firms in the secure Stats NZ datalab environment and will be used to produce the first Aotearoa New Zealand agritech industry monitoring report in 2022.

[1] The United States Studies Centre (2018) Australian Agtech. Opportunities and challenges as seen from a US venture capital perspective. https://www.ussc.edu.au/analysis/australian-agtech-opportunities-and-challenges-as-seen-from-a-us-venture-capital-perspective#how-we-define-agtech

Appendix 1. Comparison with other taxonomies

The agritech definition and taxonomy, detailed in this document, were developed for the New Zealand government's Agritech ITP work and will be used to measure the characteristics and performance of New Zealand's agritech sector and how it changes over time.

A key difference between this work and the agritech reporting done by overseas entities (such as Finistere and Israel's Start-Up Nation Finder) is that we will include all New Zealand agritech firms in our analysis, regardless of their maturity or potential for growth. In contrast, most overseas reports focus on investment-ready start-ups, with the goal of attracting venture capital. This appendix outlines the similarities and differences between our work and taxonomy and overseas taxonomies. But even where there are similarities, overseas comparisons between will be inadvisable because of differences in the types of firms.

The TIN New Zealand Agritech Insights Report focuses on investment-ready New Zealand agritech firms, and may be more comparable with some of the overseas reporting.[2]

1. Comparison with Israel's Start-Up Nation agritech taxonomy

Israel have developed an online platform for encouraging start-up investment, called Start Up Nation.[3] The Scale Up New Zealand platform is similar.[4] Some of the reporting on Start Up Nation's agritech firms has used the following 2-axis taxonomy.

Technology	**Domain**
Sensing	Crops
Data processing	Livestock
Machinery and Robotics	Aquaculture
Materials and Substances	
Biologicals	
Infrastructural components	

Summarised from https://lp.startupnationcentral.org/agri-map/

Start-Up Nation's 'Technology' categories have similarities to the 'Technology types' that we propose for the New Zealand taxonomy. Taken together, 'Sensing' and 'Data processing' are likely to be similar to our 'Digital tools' category, 'Machinery and robotics' may be similar to our 'Machinery and plant' category, and 'Biologicals' may be similar to our 'New varieties and breeding services' category. However, the Start-Up Nation taxonomy doesn't cover agrichemicals, pharmaceuticals, nutrition, or non-mechanised equipment. It is also unclear what 'Infrastructural components' are but this seems to include irrigation, solar and indoor growing systems, so may fit within our 'Machinery and plant' category.

[2] https://tin100.com/product/new-zealand-agritech-insights-report-2020/
[3] https://finder.startupnationcentral.org/
[4] https://new-zealand.globalfinder.org/

Start-Up Nation's 'Domains' are essentially the same as our 'Types of agricultural use' categories, except that there is no category for forestry and logging.

Despite the similarities, our findings will not be comparable with reports on Israel's Start-up Nation platform, as this platform focuses on start-ups and doesn't include more mature firms.

Another analysis of Start-Up Nation firms used the following alternative taxonomy.

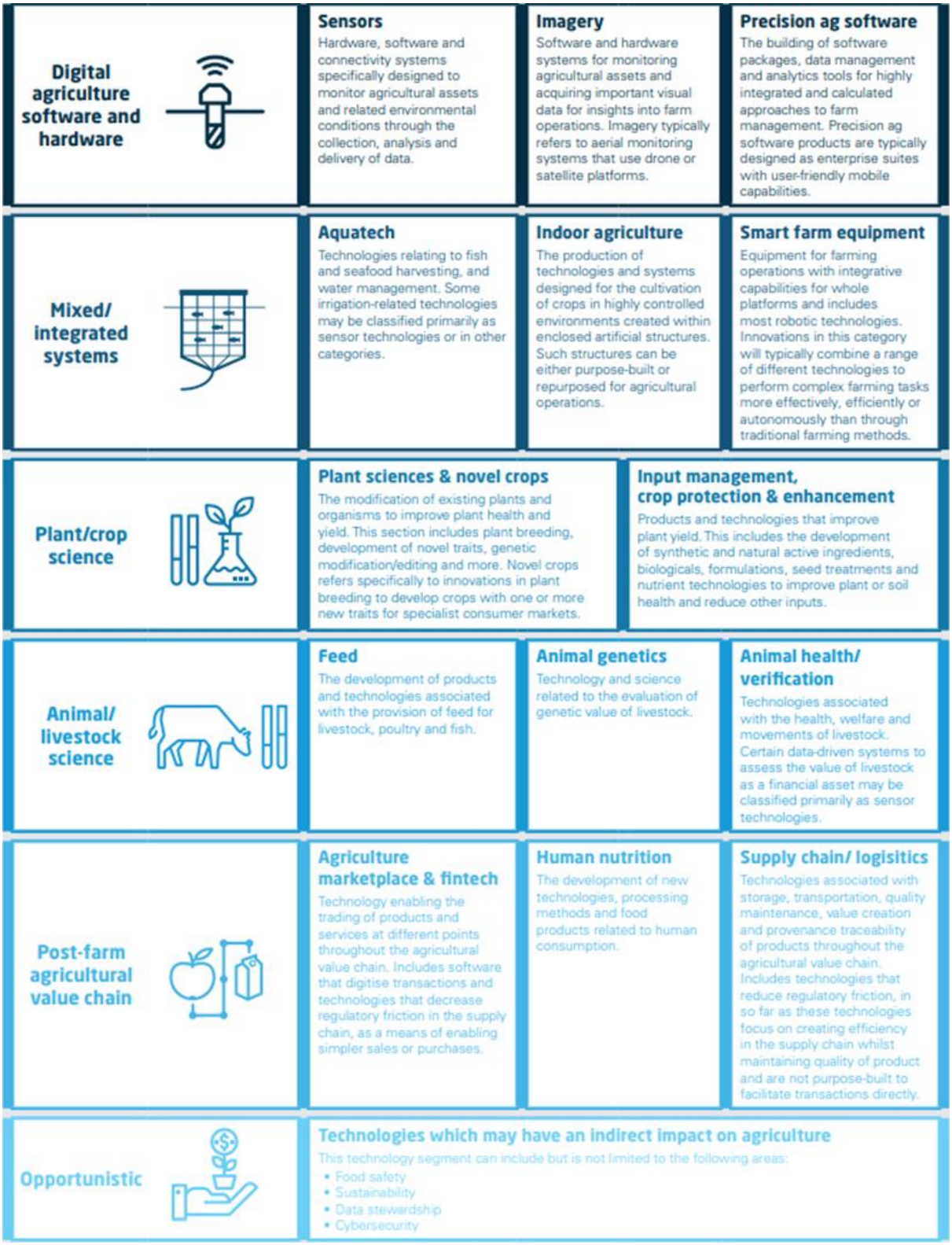
Category	Description
Biotech	Typically involves breeding of plants and bacteria with improved traits to help plant growth.
Smart Farming	Data-based technologies making use of big data and predictive analytics to help farmers make better decisions on daily farm issues (irrigation, pest management, risk management, etc).
Crop protection	Biological or chemical substances used for protecting the crops from pests & diseases, nontoxic and environmentally friendly.
Machinery and Robotics	Companies that build all kinds of robotics, machinery, and equipment used primarily to automate farm work, harvest crops and to sort it.
Irrigation & water management	Companies that are creating innovative irrigation methods and water efficiency.
Post-harvest	Technologies to reduce post-harvest losses in diverse ways (e.g. storage, packaging, treatments and climate management technologies).
Farm to consumer	Companies that leverage new business models to shorten and simplify the supply chain by connecting the farm to the end consumer. Usually done through digital platforms.
Novel farming systems	Innovative systems for growing plants, new types of greenhouses, urban farming, hydroponics, and aquaponics.
Livestock	Companies that create technology for farm animals and pets.
Waste technologies	Processing livestock manure, fertilizer run-off, harvest, and food waste to reduce harmful substances and reuse the materials.
Special crops	Companies that deal with medicinal plants from growing human tissue repair plants.
Aquaculture	Companies that develop technologies to grow things in water – algae, fish or sea food.

Summarised from https://agfundernews.com/israels-agritech-market-map-400-startups-putting-the-tech-in-agritech.html

This taxonomy has very little similarity to the one that we are proposing for New Zealand. It also has overlaps and ambiguities that make reproducible firm classifications difficult.

2. Comparison with a University of Sydney report on Australian agritech

A 2018 report published by The United States Studies Centre at the University of Sydney developed the following taxonomy.



Reproduced from page 5, The United States Studies Centre (2018) Australian Agtech. Opportunities and challenges as seen from a US venture capital perspective. https://www.ussc.edu.au/analysis/australian-agtech-opportunities-and-challenges-as-seen-from-a-us-venture-capital-perspective

Our initial work attempted to adapt this taxonomy for use in New Zealand. Subsequently, we abandoned this approach because the overlaps and ambiguities between categories made it very difficult to categorise a large number of New Zealand firms.

Our New Zealand results will not be comparable to the University of Sydney report because:

- the firms covered by the University of Sydney report are predominantly venture capital-ready firms, while our New Zealand results will include all agritech firms
- the taxonomies are very dissimilar.

3. Comparison with the Finistere Ventures taxonomy

Finistere Ventures is an investor that regularly partners with Pitchbook to produce reports on equity investment in start-up firms across the world. They have developed the following taxonomy of agritech sub-sectors.

Category	Description
Plant science	The modification of existing plants and organisms to improve plant health and yield, including plant breeding, development of novel traits, genetic modification/editing, and more.
Crop protection & input management	The development of products and technologies that when applied improve plant yield, including the development of synthetic and natural active ingredients, biologicals, formulations, seed treatments, and nutrient technologies to improve plant or soil health and reduce other inputs.
Precision agriculture	The building of software suites, data management and analytics tools for improved farm management, including the measurement of crop inputs, soil, moisture, weather, inventory, etc., typically within the realm of enterprise suites with user-friendly mobile capabilities.
Agriculture marketplace & fintech	Online marketplaces for the trading, buying and selling of agricultural goods, as well as platforms for the management of related financial transactions and administration of business relationships.
Indoor agriculture	The production of turnkey software and hardware systems designed for the cultivation of crops within buildings, often focused on either residential or commercial real estate markets, as well as related services and building of infrastructure.
Sensors & farm equipment	Hardware and software systems specifically designed to monitor a range of conditions, most frequently within close proximity, plus equipment for farming, with integrative capabilities for whole platforms.
Imagery	Equipment, software and hardware systems plus actual manufacturing of drones and satellites for aerial monitoring.
Animal technologies	Hardware and software systems specifically designed to enable management of livestock and other farm animals in general, with use cases ranging from monitoring of health to more efficient harvesting of related resources. In addition, technologies aimed at improving formulation of animal feed and medicines are also included, ranging from veterinary drug applications to the entire nutritional spectrum.

Summarised from several Finistere Ventures agritech publications, including Finistere Ventures (2018) 2018 Early-stage Agtech report http://finistere.com/news/2018-early-stage-agtech-report/

This taxonomy has considerable overlaps and ambiguities between categories which make it very difficult to use to reproducibly classify New Zealand firms.

Our New Zealand results will not be comparable to the Finistere reports because:

- the agritech firms covered by Finistere and Pitchbook data are predominantly venture capital-ready firms, while the New Zealand results will include all agritech firms
- the taxonomies are very dissimilar.

4. Comparison with AgFunder taxonomies

AgFunder is an investor in agritech that partners with Crunchbase to produce regular reports on investment in agritech firms globally, but with a focus on US firms. They cover seed through to late stage investments. Their reports focus on the number of deals and value of investments by stage, technology type, and geography.

AgFunder reports subdivide the sector by technology type but their categories change every year. Two examples of their taxonomies, one from 2018 and the other from 2015, are below.

2018 Category*	Description
Ag Biotechnology	On-farm inputs for crop & animal ag including genetics, microbiome, breeding, animal health.
Agribusiness Marketplaces	Commodities trading platforms, online input procurement, equipment leasing.
Bioenergy & Biomaterials	Non-food extraction & processing, feedstock technology, cannabis pharmaceuticals.
Farm Management Software, Sensing & IoT	Ag data capturing devices, decision support software, big data analytics.
Farm Robotics, Mechanization & Equipment	On-farm machinery, automation, drone manufacturers, grow equipment.
Midstream Technologies	Food safety & traceability tech, logistics & transport, processing tech.
Novel Farming Systems	Indoor farms, aquaculture, insect, & algae production.
Innovative Food	Cultured meat, novel ingredients, plant-based
Miscellaneous	e.g. fintech for farmers

* Excluding AgFunder's "downstream" categories, which correspond to food tech and do not fit the Agritech ITP's definition of agritech.
Summarised from: AgFunder AgriFood Tech Investing report – 2018: https://agfunder.com/research/agrifood-tech-investing-report-2018/

2015 Category	Description
Animal Health & Nutrition	We only include companies that identify agricultural livestock as a key market.
Biomaterials & Biochemicals	Include companies using biological material to produce/farm: peptides, bioplastics, non-ag inputs, microorganisms, pharmaceuticals, microbes and algae, functional ingredients/nutrients/phytoceuticals. While it could technically fall into this category, we split bioenergy out due to the high volumes of investment in this segment.
Cannabis Technology	Companies developing technologies for the cannabis market.
Decision Support Tech	Software-focused category encompassing the large majority of precision agriculture technologies, excluding those in drones & robotics, and smart equipment & hardware. It includes satellite data companies, big data, and ERP technologies.
Drones & Robotics	Companies that are building drones or robotic technologies which have self-identified food and agriculture as a key market.
Farm-2-Consumer	Companies that directly deliver food to consumers from farms, differing from food e-commerce, which involves e-grocers, meal kit delivery services, and specialist meal delivery.
Food E-Commerce	E-grocers, meal kit delivery, and specialist meal services. Excludes restaurant delivery which has less of a disruptive effect on the agriculture value chain.
Foodtech	Broad category including food processing, food enhancing technology (e.g. flavor or nutritional value), packaging, food analysis.
Food Safety & Traceability	Companies attempting to track food production, food sterilization or introduce technologies that reduce the risk of food safety concerns.
Indoor Agriculture	Farming operations that occur indoors or in a greenhouse, and the technologies that accompany them. It does not include Cannabis-related tech, which is spun out into its own category.
Irrigation & Water Tech	All technologies involving the management of water for agriculture. Some precision irrigation companies could technically fall into smart equipment or decision support tech, but we felt that this categorization would be more informative.
Smart Equipment & Hardware	Predominantly includes sensor technology, Internet of Things (IoT), and other non-robotic machinery.
Soil & Crop Technology	Includes: biological inputs and treatments, chemical inputs, genetics–based tech, new crops, seed technology.
Sustainable Protein	Companies looking to replace traditional sources of protein such as meat and eggs. These companies are mainly using plant proteins to create product.
Waste tech	Includes any products made out of food waste, wastewater treatment facilities and technology, and waste mitigation technologies.

Summarised from: AgFunder AgTech Investing Report – 2015 https://agfunder.com/research/agtech-investing-report-2015/

The AgFunder taxonomis are very dissimilar to the taxonomy we are proposing for New Zealand. They have considerable overlaps and ambiguities between categories which make them very difficult to use to reproducibly classify New Zealand firms. This, and the fact that the AgFunder taxonomies change every year, means that our New Zealand results will not be comparable to findings in the AgFunder reports.

5. Comparison with a report on United Kingdom agritech

A United Kingdom report on agritech used Standard Industry (SIC) codes to analyse national statistics on agritech firms. SIC codes are equivalent to the ANZSIC codes used in New Zealand and Australia, so in theory the UK approach could be reproduced here. However, this study's taxonomy is a very poor fit with the Agritech ITP's definition of agritech firms as it classes agricultural primary production as agritech and this activity dominates the results. Their taxonomy is summarised below. Our New Zealand findings will not be comparable to the findings of this study.

Category	Description
The farming industry	Including diversified activities such as on-farm waste and biomass (grass, energy crops, specialist crops) for non-food uses.
Plant subsectors	Crops including cereals, oilseeds, pulses, forage, potato, sugar beet, vegetables, salads, mushrooms and fruit. Including: • plant genetic improvement: genetics, genomics, biotechnology, breeding/ propagation, genetic conservation • plant health: plant production (physiology, agronomy, crop management and nutrition such as fertilizer/agri-chemicals) and plant protection (identification, diagnostics, epidemiology, management/control including biological controls / vaccines / therapeutics of pest disease and weeds) • crop storage and silage (including post-harvest storage and on-farm waste and biomass for non-food uses).
Animal subsectors	Livestock: dairy, beef, sheep, pigs, poultry (egg and meat) and aquaculture for fish (salmon, trout, shellfish). Including: • animal genetic improvement: genetics/ genomics; breeding/reproductive technologies; genetic conservation • animal nutrition, including ingredients for animal feed; grazing systems and pasture diversity • animal health and welfare (endemic diseases, exotic diseases, behaviour): identification, diagnostics, epidemiology, management/control, vaccines, therapeutics, surveillance; building and environmental design to reduce stress and promote welfare.
Environmental and physical subsectors	• Soil/ substrate management: soil physics, biology and chemistry, soil amendments (e. g. biosolids, AD digestates, water retention gels etc.); controlled traffic farming; reduced ground pressure; soil sampling; soilless growing media (glasshouse crops). • Environmental interactions (air, water, biodiversity – plant and animal; ie. technology/decision support tools to improve animal welfare &

	environmental outcomes including reducing air and water pollution, greenhouse gas emissions including quantity and quality of air and water). • Harvest and early-stage processing including harvest technologies, post-harvest cleaning, post-harvest storage (chemicals and storage conditions), on-farm waste (AD and other waste treatment plants) and biomass for non-food uses.
Engineering and precision farming	Including machinery (cultivation, crop and grass health (drilling, spraying, fertiliser application), tractors, harvesters, pickers, post harvest transport and cleaning), robotics including GPS applications and autonomous devices, sensor technology (hand held, fixed and remote including animal welfare and monitoring).
ICT systems and decision support	To support production planning, scheduling; input use efficiency (e.g. irrigation scheduling).
Advisory services and professional intermediates	No description.
Infrastructure	Buildings (including glasshouses, livestock production buildings), heating and cooling systems, storage of crop and animal products in ambient, controlled atmosphere, cold stores and freezing plants, irrigation/water management storage and distribution systems, dirty water systems, lighting (intensive livestock and glasshouse crops); 'vertical' and enclosed farming systems.

Summarised from: SQW (2015) Agri-Tech Industrial Strategy: Evaluation Scoping Study and Baseline. Prepared for the Department for Business Innovation & Skills, July 2016 https://www.sqw.co.uk/files/2414/6913/4001/Agri-Tech_Industrial_Strategy_-_Evaluation_and_Baseline.pdf

6. Comparison with a 2014 study on New Zealand agritech exports

A 2014 study of New Zealand agritech exports used the following classification of trade codes to estimate the volume and value of New Zealand agritech exports.

Category	Definition	Major sub-categories	Trade codes
Breeding & animal genetics	• Animals and semen used to create more animals. • Genetics that provide higher animal productivity or yield.	• Breeding stock. • Semen.	• Parts of HS01 (live animals). • Parts of HS05 (semen).
Seeds & plant genetics	• Plants and seeds used to produce more plants. • Genetics that provide higher productivity or yield.	• Pasture. • Cropping. • Maize.	• Parts of HS06 (live plants). • Parts of HS07 (vegetables). • Parts of HS10 (seeds). • Parts of HS12 (seeds).
Animal feed & nutrition	• Purchased food for feeding to farm animals. • Nutritional supplements for animals. • Excludes horses or pets.	• Feed grains and seeds. • Pig and poultry feed.	• Parts of HS12 (fodder). • Parts of HS23 (animal feed).

		• Calf and dairy feeds. • Liquid feeds. • Salt blocks & minerals.	
Animal health products	• Medicines used on farms to treat sick animals. • Precautionary/preventative treatments used to prevent illness.	• Drench, dips. • Vaccines and penicillin. • Endectocides.	• Parts of HS 29 (antibiotics). • Parts of HS30 (pharmaceuticals). • Parts of HS40 (Gauze, etc). • Parts of HS9018 (Syringes).
Fertiliser	• Natural and synthetic soil additives used to increase fertility. • Pure compounds and mixtures.	• Nitrogenous. • Phosphatic. • Potassic. • Mixtures, blends, other.	• All of HS31 (fertiliser).
Agri-chemicals	• Chemical products used predominantly in agriculture.	• Glyphosates. • Herbicides for pasture, crop and brushweeds. • Other farm-targeted chemicals.	• Parts of HS29 (chemicals).
Fencing supplies & equipment	• Equipment used to construct on farm fencing, either electric or not. • Fixed or mobile units and structures. • Excludes wooden fence posts.	• Wire, tape & cable. • Reels, parts, standards. • Gates, etc.	• Parts of HS 39/56. • Parts of HS72 (Iron/steel wire). • Parts of HS85 (Electrical supplies). • Parts of HS90 (Measuring equip.).
Farm tools & other hardware	• Wide range of farm tools and equipment. • Excludes predominantly non-farm use products (e.g. hammer). • Excludes large machines or systems.	• Drench guns, applicators. • Shearing equipment.	• 8201 (Hand tools, spades, etc). • 8203 (Files, rasps, etc). • 820559 (Other hand tools). • 901831 (Drench guns, etc).
Pumping, water & irrigation	• Parts and equipment used to create and maintain on-farm water systems. • Excludes human toilet, bath and plumbing where possible.	• Commercial irrigation systems. • Metal pipe fencing. • Pipes and hoses. • Valves and fittings. • Culverts, troughs and tanks.	• Parts of HS 39 (Tubes, pipes, etc). • Parts of HS 40 (Gaskets, washers). • Parts of HS73 (Tanks, etc). • Parts of HS 82 (Tools, etc). • Parts of HS84 (Pumps).

Machinery & systems, & parts	• Large/complex on-farm machinery. • Complete farming systems. • Includes weigh machinery, sprayers. • Dairy machines, equipment & systems. • Excludes generic business equipment (e.g. photocopier).	• Dairy systems. • Weigh machines. • Other.	• Parts of HS84 (Machinery/systems).
Farm vehicles, cultivators, etc.	• Tractors and other farming vehicles. • Cultivators, harvesters, seeders, spreaders, etc. • Excludes road cars, utes, motorcycles and quad bikes.	• Cultivating. • Planting & seeding. • Harvesting. • Sprayers. • Hay and forage.	• Parts of HS84 (Spreaders, etc). • Parts of HS87 (Tractors, etc).

Summarised from: Coriolis (2014) New Zealand's Agritech Sector. September 2014 v1.0a https://coriolisresearch.com/pdfs/coriolis_nzte_agritech.pdf

This study provided useful insights on agritech exports and an updated analysis, extending the export value findings to 2018, was published in the Agritech ITP. However, the fact that this taxonomy focuses on products for pastoral farming means that it is only a partial fit with the Agritech ITP, which includes non-pastoral farming in its definition of agritech. In addition, most digital products and services cannot be identified using this taxonomy.

The new agritech monitoring work that we are initiating for New Zealand will generate data on agritech exports, but its findings will not be comparable with the 2014 Coriolis report as it will include non-pastoral agritech.

7. Other unpublished taxonomies

Comparison with Callaghan Innovation's classification

Callaghan Innovation categorise their agritech customer firms into sub-sectors, using the scheme below.

First level categories	Second level categories
Environmental management	Pest & biocontrol. Supply chain. Water, cleaning and waste.
Animal & crop health	Genetics & breeding. Nutrition. Pharmaceuticals.
Data solutions	Analytical testing. Sensors. Software.

Growing & harvesting	Automation & equipment. Farming & aquaculture. Robotics & UAV.
TBC – not yet named	Fermentation.* Indoor growing.

* includes companies using fermentation for animal feeds, biopesticides, or crop nutrition. Does not include companies using fermentation for human food or health.

Source: information provided to MBIE by Callaghan Innovation, 16 October, 2019

This taxonomy has some similarities to the technology types in the taxonomy that we are proposing for monitoring New Zealand agritech. Among the first level categories in this taxonomy, 'Data solutions' may match our proposed 'Digital tools' category. And among the second level categories, 'Automation & equipment, 'Robotics and UAV' and 'Indoor growing' may partially match our 'Machinery and plant' category. 'Nutrition' and 'Pharmaceuticals', and 'Pest & biocontrol' may partially match our 'Agrichemicals, pharmaceuticals and nutrition' category. But there are a number of other areas where the taxonomies do not have a good match. Callaghan Innovation are likely to continue to use a taxonomy that best meets their needs and there is no need to align taxonomies unless that would provide benefit for Callaghan Innovation.

Comparison with New Zealand Trade and Enterprise's classification

In at least one report, New Zealand Trade and Enterprise have categorised their agritech customer firms into sub-sectors, using the scheme below.

Categories
Biotechnology
Digital technology
Innovative foods
Novel farming systems
Precision agriculture
Robotics and machinery
Supply chain integration/optimisation
Other*

* Includes companies whose core focus is not agritech (e.g. general agri-services providers).

Source: New Zealand Trade and Enterprise agritech companies by technology, slide 6, Callaghan (2018) Agritech in New Zealand. Prepared for NZ Investment Taskforce. 29th August 2018.

This taxonomy has some similarities to the technology types in the taxonomy that we are proposing. 'Digital technology' may match our 'Digital tools' category and 'Robotics and machinery' may partially match our 'Machinery and plant' category. But there are a number of other areas where the taxonomies do not match well. New Zealand Trade and Enterprise are

likely to continue to use a taxonomy that best meets their needs and there is no need to align taxonomies unless that would provide benefit to New Zealand Trade and Enterprise.