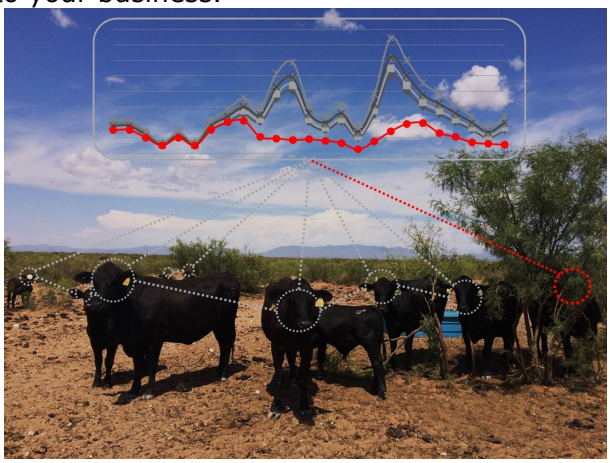
AGRITECH CHECK – YOUR NEXT STEPS

The purpose of the CQUni AgriTech Check is to provide you with a guide of the range of technologies available that may be of value to your business.



This report is not designed to tell you what to purchase, but where to look next and what questions to ask to ensure that you find the right equipment to help you achieve your business objectives.

The key thing to remember when looking to invest is to identify the decision that you want the technology to help you make.

Making the right decisions makes dollars – if a technology doesn't help you do this, it's not worth it.

Ask yourself, will this type of technology:

- Increase my production?
- Reduce my costs?
- Increase my price received?
- Increase my sustainability?
- Make me sleep better at night?

If the answer is "No" to all of these questions, then it is time to think again and find a different focus area within your business for your AgriTech investment.

DIGITAL FARM MAPPING

You have indicated that you are interested in developing a digital farm map. A digital farm map is like a traditional paper map, but is stored electronically and access by a computer or smartphone.

What are the benefits?

There are a number of benefits to developing developing a digital farm map and its not as complicated as it initially sounds. A digital farm map allows you get accurate data on the size of your property and individual paddocks.

This data can be useful when estimating stocking rates, planning infrastructure such as new fence lines or watering points, or simply ordering supplies for paddock-based activities like herbicide applications, that require accurate areas of the land to estimate the volume to be ordered.

While traditional paper-based (and acetate overlay) mapping is extremely useful, having a digital farm map opens up access to additional sources of new and useful information.

How should I go about getting a digital farm map?

There are a number of ways in which you can create a digital farm map. The first option is free-ware, with several mapping systems providing free basic property mapping that are either generic (e.g. Google Earth) or farm specific (e.g. Data Farming).

There are also a number of farm-specific systems that require a subscription fee (e.g. FarmMap4D). As you might have guessed, the free platforms have limited capabilities while the systems that cost money offer more customised features.

Some systems have been developed with specific farm industries in mind – for example, Data Farming was primarily developed for cropping – or even specific regional industries, with Farm Map 4D focusing on northern beef production systems.

While the basic functionality required of digital farm maps can be achieved using one of the free systems, if you choose to use one of these services be prepared to do a bit of learning for yourself as there will be little (if any) customer support.

Some of the more advanced digital farm mapping systems allow you to access the data on a smartphone or tablet whilst out in the paddock. This usually – although not always – requires your device to have internet connectivity. This feature can be really handy if you're trying to input data into your mapping system while out in the paddock.

One key thing to look out for is the ability to export the data from your farm mapping system in a format that can be input into other mapping systems. If at some point you want to change to a new or more advanced mapping system, having an export function means you can simply take it out of the existing system and upload it into the new one.

Commonly used file formats include the "shape" file format (.shp and other files associated) and Google's "kml" (files ending .kml or .kmz).

Where to start?

If you are only just starting out, the best place to begin is by downloading Google Earth Pro. This is a free platform and will provide you with some very basic mapping functionality. It will allow you to "digitise" in your farm and paddock boundaries, which is simply drawing boundaries lines over a background satellite image.

Supplier	Contact	Costs	Insights	Are they at Beef21?
Google Earth Pro	www.google.com/earth/	Free	A good place to start, with user support through tutorials online	
DataFarming	www.datafarming.com.au	Free for basic mapping and satellite imagery with some costs for advanced features	A good place to start, particularly if you want to start exploring satellite data.	
Agri-Webb	www.agriwebb.com	Free trial followed by paid subscription starting at $650/farm.	Combines mapping with record keeping.	R2
Phoenix by Agdata	www.agdata.com.au/products/production/mapping/	From $33/mth	Combines mapping with record keeping. Available in desktop or live versions.	Sidney Kidman Pavilion - 11S & 12S
Agforce Mapping Services	www.agforceqld.org.au/knowledgebase/article/AGF-01047	Calculated based on the level service provided	Available to both AgForce members and non-members on a fee-for-service basis.	Walter Pearce Building - 35S, 36S, 37S, 38S, 39S, 40P
ESRI ARC GIS	www.esri.com/en-us/home	License costs vary	An advanced Geographical Information System used by many professionals.	
QGIS	www.qgis.org	Free	An advanced open source Geographical Information System used by many professionals.	

What questions should I ask?

Your questions should be focussed on the specific application of the farm map you are going to develop to meet your business objective. Here are a few suggestions to get you started:

- Does the price include all mapping features or do I need to pay more for additional services once I've started using the system?
- Does the system provide 3-dimensional landscape mapping (important for planning reticulated watering systems)?
- Can I import other mapping files (e.g. .shp or .kml) into this system, or do I have to start from scratch?
- Can I export the map I created in a standard geographical information file format (e.g. a shape file or .kml)? (This is important as it allows you to change to a different provider later down the track without having to redo all your maps)
- Does the farm mapping system allow me to take the map out into the field on a smartphone or tablet? And will it work offline?
- Does the map integrate into any other farm management software? If so, what?

AUTOMATED WATER, RAINFALL, AND SOIL MOISTURE SENSORS

AgriTech in beef production doesn't just have to focus on animals. There are many auxiliary solutions that can support decision making on your property. These include, but are not limited to, camera, moisture probes, weather stations, fencing monitors, pasture assessment, and irrigation management. This list goes on, and new solutions continue to join the market all the time.

What are the benefits?

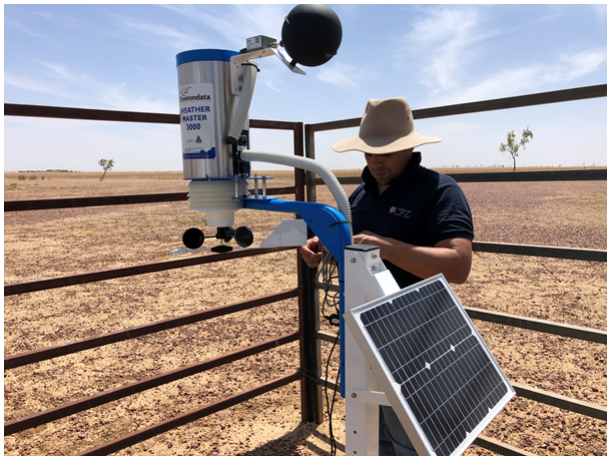
Of course, these products all claim increased efficiency and productivity under the right circumstances, but how these solutions fit into your own system need to be considered.

In some cases, such as water monitoring, calculating the labour savings can quickly support purchasing a product. In other instances, the value is harder to quantify. This is where researching the available products and having a good understanding of how they fit into your system will prove valuable.

For example, deploying multiple rain gauges on a property is unlikely to provide direct cost savings, but can support decision making, such as estimating forage availability, stocking rates, and paddock rotations. The outcomes of this can increase productivity.

Finding the right AgriTech solution for your problem can improve productivity and/or provide peace of mind, but don't jump at the first option you find as there are several points to consider.

How should I go about finding the right sensors for my property?



It can be a little tricky to find the right solution for your property, but increasing amounts of information are available through vendors and more and more case studies are reporting the benfits of these products. As livestock properties continue to embrace AgriTech, more vendors are coming to market increasing the number of available options. Be sure to see what each of the vendors can do for you now and into the future. Think about the scalability and what other products they may offer.

System integrators tend to have hardware and software solutions to multiple problems, e.g. rainfall measuring, trough monitoring, and cameras. If you intend on investing in multiple AgriTech solutions, it may be worthwhile researching product lines from these vendors and selecting one based on your goals.

Other vendors tend to focus on solving one problem very well. While they may offer the best product for your situation, the addition of more sensors to your property may bring with it additional infrastructure requirements, multiple apps, and multiple subscriptions.

Increasingly, the aggregation of information from multiple AgriTech products has gained traction. Standalone aggregator platforms are relatively new but offer a single dashboard view of all of the data on your property. Information, such as weather stations, weather forecasts, EYCI prices, soil moisture, and livestock locations can all be presented in a single place, reducing the need for multiple apps and increasing the speed of decision making. If you are looking to purchase several products from multiple vendors, consider checking if they support these new aggregation platforms.

Where to start?

Start with a problem and look into the current AgriTech solutions. Once you have found a product and vendor that can help solve these problems, see what else they may be able to offer you to help with decision making on farm. Consider if a system integratory or a standalone product is right for you and think about if you would like to leverage aggregator platforms in the future. Talking to Research and Development providers, such as CQUniversity, can also be a great starting point to assess what is currently available, where the value lies, and what could fit into your system.

Supplier	Contact	Costs	Insights	Are they at Beef21?
Station Innovation	www.stationinnovation.com.		Includes a range of sensors and management tools (e.g. pump automation)	

What questions should I ask?

The specific questions will change depending on sensor type, but the guidelines below will give you some idea of how suitable the vendor is for your property and situation.

- Do you support aggregator platforms?
- How do your devices communicate (particularly in remote areas)?
- Can other products communicate using the same infrastructure?
- I'm interested in "X" product, but what other products do you offer in your ecosystem?
- What do the tangible benefits of using your system look like? How do you achieve them?
- At what frequency do your products record data, or give alerts?
- How do you provide alerts?
- Do you have any new models in the pipeline?
- Do you have any other products being developed?
- Do you offer after sales support?
- How is the information reported to me?
- Can you walk me through your app?

FEED BASE MONITORING

You have indicated that you are interested in feed base monitoring, recording, and management technologies. These systems allow you to collect feed base data and interrogate it to improve decision making around pasture management. There are broadly two parts to these - the first is the system that manages the data and does calculations to match feed to demand, the second (and less common) is the sensor system to automate the collection of pasture measurements.

What are the benefits?

Recording data on the amount and quality of pasture and matching this with the nutritional demands of grazing livestock improves the productivity of both your pastures and your livestock. Some producers in northern Australia estimate that this could improve returns by as much as $80/AE (MLA Report B.NBP.0549). In Southern grazing systems, improved feed-base management has been estimated to be worth over $50/ha of increased profit (MLS Report B.GSM.0004).

How should I go about selecting a feed-base monitoring, recording, and management system?

There are many ways to approach this - one of the first steps is to understand your production system and the key information required to make better decisions around feed budgeting.

In Northern Australia, one of the key decisions to be made is setting the long term carrying capacity of your property. This is best done using one of the digital farm mapping platforms that incorporate this function and assess land area against long term safe carrying capacity recommendations. A good starting point to assist you in determining your long term carrying capacity is to get in touch with your state's department of primary industries. For Queenslanders, check out the Queensland Government's Long Paddock initiative (www.longpaddock.qld.gov.au/forage/), which generates a carrying capacity report that is sent to your email.

In pastoral regions, the next level of more refined management involves short and medium term paddock feed budgeting. This involves calculating the amount of feed available and the likely demand from livestock. A good place to start learning about this is the freely available Future Beef Stocktake Plus app (developed by MLA and QDAFF).

In more intensive Southern Australian grazing systems where rotational grazing may be used, a more refined feed base management system may be of value. These allow you to plan around multiple paddock rotations and more dynamic pasture growth characteristics. Some systems use direct biomass measures (kg/ha), whilst others use animal grazing days. The end result (working out the balance of feed available and feed demand) is basically the same.

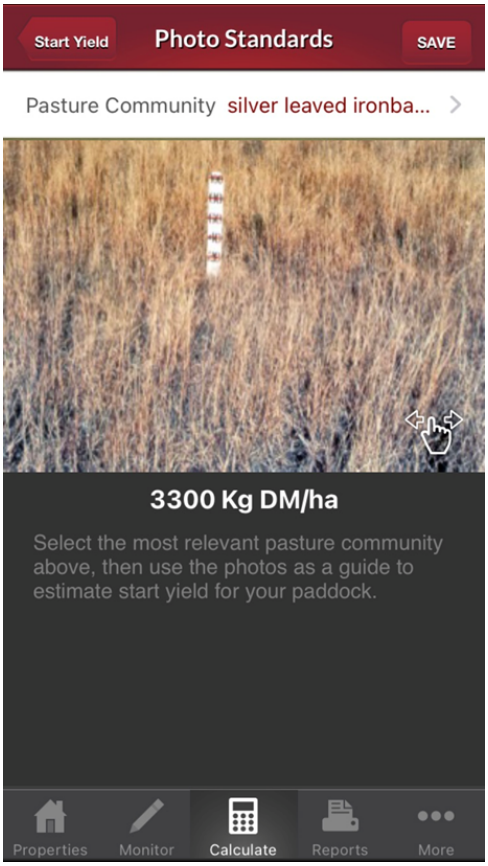
Getting started

If you have never undertaken a pasture budget before and have access to a smartphone, try downloading the StockTake Plus app or exploring MLA's freely available Stocking Rate Calculator or Feed base planning and budgeting tool within a web browser.

If you are already familiar with some basic feed budgeting, then it would be worth exploring some of the more advanced systems that integrate mapping, sensing, and rotational planning.

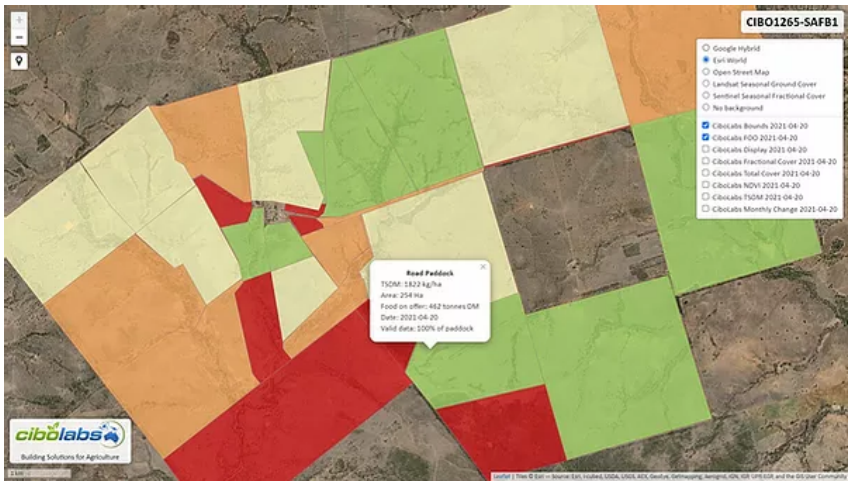
One of the key challenges in this area is obtaining good estimates of pasture quality and quantity to input into the calculations. A simple, accurate, and free way to do this is to directly measure using quadrat cuts, but this is very time consuming. A quicker way is to use photo references, which are available in some systems.

Another technique for assessing pasture involves the use of satellite sensing. Data from satellite imagery is converted to biomass measures (more commonly DMkg/ha). These systems are usually integrated with a farm mapping package and present data visually as a map. Some of these systems will require you to undertake periodic calibrating cuts and while this is time consuming, will increase the accuracy of the estimates the system provides you.



An example of a photo reference used for comparison with your pastures. Source: StockTake Plus.

One final piece of information that is required to complete a feed budget is the growth rate of the pasture (expressed as DMkg/ha/day). This information is most commonly derived from plant growth modeling, based on weather data and some satellite data. You can get estimates of growth rates from places like the Long Paddock FORAGE system (www.longpaddock.qld.gov.au/forage/). Some systems infer this growth from rainfall directly as a change to the potential animal grazing days and many producers find this a more intuitive way of handling the data.



An example of biomass calculation using satellite imagery. Source: Cibo Labs

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Supplier	Contact	Costs	Insights	Are they at Beef21?
StockTake Plus	www.stocktakeplus.com.au/	Free	A great way to start out using feed budgeting technology	MG161
Feedbase planning and budgeting tool	etools.mla.com.au/fbrp/#/	Free	Good for more detailed feedbase planning	OP182
Stocking rate calculator	etools.mla.com.au/src/#/	Free	Great for doing a quick calculation of feed available and demand	OP182
The Long Paddock	www.longpaddock.qld.gov.au/forage/	Free	Input details into a web browser to receive data on estimates of total pasture growth	MG161
Maia Grazing Lite and Pro	www.maiagrazing.com/	Free Lite version to enable you to trial. Full Pro version is subscription based	Advanced feed-base data recording and planning	WP82
Pasture.io	pasture.io/	Subscription model	Designed for the grazing dairy industry this system has application in high rainfall beef systems. Provides estimates of pasture growth rate	
Pasture Key	www.cibolabs.com.au/pasturekey		Provides estimates of pasture biomass from satellite. Can be integrated with other systems (e.g. AgriWebb & Pairtree)	TY11
Grazing Management	www.agriwebb.com/au/features/grazing-management-software/	Subscription cost as part of package	Integrates data from Cibo labs with other key property information	R2

What questions should I ask?

- Is this system design for my particular region and operation?
- What is the cost of different features of the system? Will I need to buy more advanced modules later on?
- Where is the data stored once I input it into your system?
- What data do I need to input into the system? E.g. current biomass, growth rates, wastage.
- How does the system display the information? Does it provide a visualisation of all the information you need to make the key decisions?
- If you have more than one person on the property, can the system handle multiple users and data updates (particularly when offline and out of WiFi/cell coverage)?

HERD AND ANIMAL PRODUCTION DATA RECORDING SYSTEMS

Recording data on your herd, or even better, each animal, provides valuable information for decision making. Many people use a simple paper herd book, which is great, however, developing a digital recording system can provide more powerful insights into your business. Digital systems can also be backed up so that the data is not lost (when written records disappear). Data management systems most commonly require you to record the identity of an animal or herd along with a characteristic. These characteristics might be as simple as pregnancy or calving status, through to more complex information like liveweight gain.

One of the key requirements of these systems is to have a good identification system for animals. This is most commonly a visual identification ear tag, however, the RFID (NLIS) ear tag can also be used to automate the process of data collection. This is particularly the case for the collection of liveweight data using scales in the stockyards.

What are the benefits?

The key benefits of collecting data on herd and animal productivity come about when key decisions are being made. These might be decisions around selection of heifers for retention, which cows to cull, or when to sell animals based on market specifications.

More advanced animal management software systems will integrate with the National Livestock Identification System and can streamline the paperwork associated with animal sales and transfers.

Using a data management system in conjunction with a set of yard scales can provide key data for animals being sold into a grid based pricing system. Knowing liveweight data, and growth rate data, makes it more likely that you can meet the market specifications.

Where to start?

You can start recording simple animal data in a basic software system without too much financial outlay. Recording simple data, like which cows have calved and when, can be done without buying any expensive sensors. Many software systems provide free trials to their platforms, which are worth investigating. If you think you want to do more than simply record basic animal data in the future, it is worth exploring what each system can do in addition to these features. When it comes to recording data, nothing beats when you're out in the paddock or in the yards - double shuffling data from a notebook to the computer back in the office takes time. Many software systems have a smartphone app, which allows you to input data wherever you are. This can be really useful, but you need to check that these systems will still work offline or in areas of poor connectivity.

Who supplies this service?

There are broadly three categories of suppliers in this space - the first are animal identification systems (usually ear tags), the second are the animal measurement system suppliers (weigh scales), and the third are software providers.

Animal identification technologies

Supplier	Contact	Costs	Insights	Are they at Beef21?
Alflex	www.allflex.global/au/		Suppliers of ear tags for animal identification	R34
Enduro tags	www.endurotags.com.au/		Suppliers of ear tags for animal identification	
Leader Products	www.leaderproducts.com/en		Suppliers of ear tags for animal identification	

Animal measurement technologies

Supplier	Contact	Costs	Insights	Are they at Beef21?
Te Pari	www.tepari.com/au/		Live weight scales with automated live data feed to smart phone app	TY29A
Gallagher	am.gallagher.com/en-AU		Liveweight scales and RFID tag readers	
Tru-Test	www.livestock.tru-test.com/en-au		Liveweight scales and RFID readers	

Software suppliers

Supplier	Contact	Costs	Insights	Are they at Beef21?
Practical Systems	www.practicalsystems.com.a			
Gallagher	am.gallagher.com/en-AU		Animal performance recording software (cloud based with mobile apps)	
DataMars Livestock	livestock.datamars.com/		Animal performance recording links with Tru-Test	

What questions should I ask?

- How much does the system cost? Do I pay more for more advanced features?
- Does the system integrate with NLIS reporting requirements?
- Does the system provide more advanced features that might be of interest in the future?
- Is the system reliant on internet connectivity?
- Can you have more than one user?

GENETIC EVALUATION AND MANAGEMENT TECHNOLOGIES

You have indicated that you are interested in using objective genetic measurement tools. So let's get started!

What are the benefits?

There are a number of benefits to utilising objective genetic measurement and selection tools, the most important of which is accelerating the rate of improvement in your herd so that you can maximise your business returns.

When used in conjunction with visual selection techniques (AgriTech is designed to complement these methods, not replace them), genetic measurement tools can support joining and culling decisions, ultimately increasing the rate of herd improvement.

The end results will depend on your business focus, and can include more beef per hectare, higher joining and calving rates, a shorter tail in your mob, faster growth rates, better fat cover, improved calving and weaning weights, or simply more confidence that you have purchased the right bull on sale day.

Objective genetic selection tools take the guess work out of your decisions by identifying those animals with the most genetic potential for your business, across the mob and right down to the individual animal level.

Where do I start?

The starting point is defining your breeding objective. Whether you are a stud or commercial breeder, this will influence the types of technology you need to achieve that breeding objective.

For breeders investigating the objective selection technologies for the first time, your next stop should be a visit to your local beef genetics extension officer, or attending a BullSelect workshop run by either Southern Beef Technology Services (SBTS) or Tropical Beef Technology Services (TBTS).

Starting out requires an understanding of how the different genetic traits are measured and how to understand the data that is provided by BREEDPLAN and stud breeders. One fo the oldest forms of AgriTech is a pen and paper, so come with an open mind and be ready to learn!

This information will help you on sale day when interpreting Estimated Breeding Values (EBVs), which predict how progeny are likely to perform. EBVs are provided by studs so that you can select the right bull to improve your herd in the areas which affect your business's profit drivers.

Where to next?

Once you understand what is measured and how that information is interpreted, the next step on the tech journey is measuring your own animals' performance. Performance recording can be as simple as using NLIS technology - wand or panel readers - to record animal identification within herd management software and relevant information about each animal, such as weight at weaning. You can then connect additional technologies to add genetic measures to your herd recording, such as pregnancy testing, to add further value to your genetic records.

Studs or more intensive breeding operations can use this information when using artificial insemination technologies to maximise the use of the most advanced genetics in the herd.

If you are a stud breeder participating in BREEDPLAN, you will need to comply with its performance recording protocols, which have been implemented to ensure consistency in data gathering and analysis methods across a wide range of traits. This improves the accuracy of EBVs for both vendors and buyers of breeding cattle.

The more breeders that participate in BREEDPLAN, the more accurate EBVs become, as do the predictions made from DNA testing. DNA testing is the most advanced form of objective genetic assessment technology available, with tests available that are customised to both stud and commercial producers, and for different breeds.

However, the range of traits that can be currently tested for beef cattle is limited - use of DNA technology therefore should be aligned with your business and breeding objectives to ensure you obtain maximum value from the information provided.

Supplier	Contact	Costs	Insights	Are they at Beef21?
SBTS / TBTS	sbts.une.edu.au/, tbts.une.edu.au/	Free	A great place to start – these extension services have the specific objective of maximising the understanding and use of genetic technologies.	Durack Pavilion – D9 & D10
BreedPlan	breedplan.une.edu.au/		Offers bull breeders the potential to accelerate genetic progress in their herds, and to provide objective information on stock they sell to commercial breeders.	MLA Pavilion or visit your respective breed society for more information
Breed societies			Provide members with access to Breedplan and retail genomic tests on behalf of suppliers, including Neogen.	Various
HerdMaster	www.herdmaster.abri.une.edu.au	Basic software free	Stores and reports on genetic program results, and is compatible with BREEDPLAN.	
DataMars	www.datamars.com		Retails NLIS tags, weighing hardware and stock management software.	Elders – R17
Gallagher	am.gallagher.com/en-AU		Retails NLIS tag readers, weighing hardware and stock management software.	Nutrien – OP 143
Tru-Test	www.livestock.tru-test.com		Retails NLIS tag readers, weighing hardware and stock management software.	Elders – R17
Optiweigh	www.optiweigh.com.au		Paddock-based front-foot weighing hardware and individual animal data recording software	Tech Yards - 32
International Genetics Solutions	www.internationalgeneticsolutions.com/		Offers beef producers the opportunity to evaluate genetic performance across several breeds, and provide objective information to support bull and female selection.	

Supplier	Contact	Costs	Insights	Are they at Beef21?
AgriWebb	www.agriwebb.com	Basic software free	Compiles daily farm records into reports including livestock reconciliation and stocking rates.	R2
Maia Grazing	www.maiagrazing.com	Basic software free	Uses metrics to show under or over-stocking, plus individual and mob performance records.	WP82
Sapien Technology	www.sapien.com.au		Individual animal management software and hardware	Durack Pavilion - D33
DataMuster	www.datamuster.net.au	Software free; hardware rental from $200/month	Links paddock based weighing systems with analytical software to track animal performance in real time. Can identify top genetic performers, maternal parentage and date of calving.	R4
Neogen	www.neogen.com	Depends on test types.	The only genomic laboratory in Australia with DNA tests for a range of cattle traits.	Durack Pavilion - D40
Zoetis	www.zoetis.com.au	Depends on test types.	DNA tests for a range of cattle traits.	Durack Pavilion - D44
ST Genetics	www.stgenetics.com.au		Semen analysis to determine sex of progeny from AI breeding programs.	Durack Pavilion – D18
Semex	www.semex.com		Semen and embryo supplier.	Durack Pavilion - D45
Genetics Australia	www.genaust.com.au		Semen, embryo and equipment supplier.	Durack Pavilion - D41
Rocky Repro	www.rockyrepro.com.au		Semen and embryo collection and analysis.	Durack Pavilion - D37

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Supplier	Contact	Costs	Insights	Are they at Beef21?
Beef Breeding Services	www.beefbreeding.com.au		Semen and embryo collection and analysis.	Durack Pavilion - D8
Agri-Gene	www.agrigene.com.au		Artificial breeding company, importing and exporting semen and embryos.	Durack Pavilion – D7

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What questions should I ask?

Your questions should be focussed on your specific breeding objective for your herd. Here are a few suggestions to get you started:

- What genetic traits does the technology report on?
- Is the software compatible with my NLIS reader and the NLIS database?
- Does the paddock-based hardware require an internet connection?
- Can animal data be collected offline and uploaded to the software later?
- Does the service allow you to compare your herd with other animals?
- Does the service allow you to compare the performance of individual animals within your herd?
- Does the service allow you to compare the performance of individual animals between breeds?
- How do I interpret the reports provided by the technology?
- How will the technology help met to select better genetics?
- How do I balance this new information with other insights I have and into the genetic performance of my cattle? E.g. information provided by bull suppliers or visual assessments.
- When reading reports from the technology, which traits or measures should I put the most emphasis on?
- What is the cost of the technology/service? And what financial return should I expect from that investment?
- Do I have to be a member of a breed society to use this technology?
- Can you help me redesign my breeding program to maximise value from your technology?
- I'm going to have more questions later - do you provide after sale support?

AUTOMATED LIVESTOCK MONITORING AND MANAGEMENT

There are a range of technologies emerging that automate the process of collecting measures of animal traits using in-paddock systems. These systems face fewer limitations when it comes to providing a consistent power source (usually a solar panel), data storage, and connectivity, and provide a reliable method to remotely monitoring your animals on a regular basis. Most in-paddock systems utilise an incentive to encourage regular visitation, e.g. supplementation or water. The most effective incentives are high value and cannot be accessed elsewhere, such as a sole watering point.

The most "commercially ready" tool that is currently available is the walk-over-weigh system, which is designed to capture animal liveweight. Companies providing walk-over-weigh systems may be focussed on providing the hardware alone, or have additional algorithms to gain more value and information from your animal liveweight data, e.g. calving date detection. This will be something you will need to consider when looking at walk-over-weigh providers.

Other in-paddock tools, like auto-drafters, are still in their infancy, however, it is possible to access auto-drafting technology if you don't mind the high price tag.

What are the benefits?

As with any investment, the cost of benefits should outweigh the cost of the item itself. The initial outlay for a walk-over-weigh system can range from $7,500 to upwards of $28,000, however, this needs to be weighed up against the value of consistent liveweight data, improved productivity and efficiency, and savings in labour units.

The information gathered using in-paddock walk-over-weigh technologies can be used to provide regular, accurate data to enable better individual animal management and assist in making management decisions. This increased level of individual animal monitoring can dramatically enhance genetic progression within herds, allowing commercial producers to more accurately select for animals with desirable traits. When integrated with auto-drafting technology, these sensors allow producers to remotely subset the herd for supplementation, health treatments, or to sell.

How should I go about implementing these systems?

When investing in a remote monitoring unit, there are many things to consider, the first of which is, what information do you want to collect? Are you interested in genetic performance recording, growth rates, or suitability for market?

It is also important to think about the logisitics and suitability of differing technologies to your operation. Do you need a portable unit to move from paddock to paddock? Or will the system remain in one area? What attractant will you use to encourage animals to visit the system and are they available elsewhere?

Where to start?

The first step would be to determine which supplier would best suit your needs. Get in touch with a prospective supplier and have a chat about your goals and property set up and how their system works, to figure out whether you would be a good match.

Supplier	Contact	Costs	Insights	Are they at Beef21?
DataMuster	www.datamuster.net.au/	Become part of a research project, low set up costs, yearly contract, ongoing support provided.	P4	
Tru-Test	www.livestock.tru-test.com/en-au/product/remote-wow-systems	A good place to start if you are wanting to invest in a portable unit with an auto drafter.	Elders, Nutrien, SBB?	
Gallagher	store.am.gallagher.com/am/au/en_AU/animal-management/weighing-and-eid/weigh-scales-and-data-collectors/c/weigh-scales-and-data-collectors	A good place to start for high end data collecting.	Elders, Nutrien, SBB?	
Optiweigh	optiweigh.com.au/	Best placed if you don't have water infrastructure, such as troughs and dams and will need to rely on attracting cattle through supplement feeding.	Ken Coombe Tech Yards	

What questions should I ask?

- How much is the start-up cost?
- How much is the monthly/annual subscription?
- What sort of support will you provide me? If so, will that cost extra or is it free?
- Is there other equipment I will need to purchase on top of the system (such as panels for enclosure fencing)?
- How is the data being transmitted? E.g. 3G/4G, satellite
- Are there extra costs associated with a satellite connection?
- Are there offline options?
- If a new/updated version of the platform becomes available, will my system get updated automatically? If so, is there an extra cost?
- How can I access the data? Is there a dashboard available and if so, can you walk me through it?
- Where will my data be stored if an outage occurs?
- Will I need to train my cattle to use these systems?
- If I am enclosing the sole watering source in the paddock, how do I know that my cattle are accessing water?
- How is the system powered?
- What is the anticipated lifetime of the product?

ON-ANIMAL SENSORS AND VIRTUAL FENCING

You have indicated that you are interested in using on-animal sensors or virtual fencing technologies.

These technologies are only really now emerging in the beef industry. This means that they may not necessarily "work out of the box", and you need to expect to be an "early adopter" and you will likely be involved in the development process. These technologies are great candidates for on-farm research and development projects, such as MLA's Producer Demonstration Site program.

What are the benefits?

On-animal sensors

On-animal sensors, a.k.a smart tags, allow animals to be monitored 24 hours a day 7 days a week, a frequency that cannot be achieved through physical observation of animals alone. The frequent monitoring means that it is possible to remotely obtain up to date information about your animals, with the potential to diagnose a range of issues in a timely manner.

The information gathered by on-animal sensors fall into two broad categories: location and behaviour. Location sensors (GPS/GIS) collect information on the location of animals and can be used to assist producers to remotely locate animals to improve mustering times, understand grazing distributions of animals, and/or understand water source usage. Behaviour sensors (accelerometers and IMU) collect information on the movement of an animal and can be used to determine what behaviour that animal is exhibiting, i.e. standing, grazing, walking, or ruminating. This information can be used to help identify changes in daily behaviour and alert to instances where an animal's physiological state has changed, i.e. that an animal is lame, impacted by disease or other health issues, experiencing oestrus, or has started calving.

Virtual fencing

Virtual fencing (VF) enables the management of the location of grazing animals. This technology enables graziers to implement more complex grazing rotations without having to build internal fencing. The primary benefits come through improved pasture utilisation and reduced labour costs. While VF has a lot of potential, there are still some key challenges in the deployment of these systems.

How should I go about setting up an on-animal sensor system?

When investing in an on-animal sensor system, there are a number of things to consider, including:

- What is it that you want to achieve by using on-animal sensors?
- Are you wanting to collect information on all your animals or just a selection, e.g. bulls or breeding females?
- Would a collar or ear tag device work best for you?
- What area do your animals inhabit? Is it one large paddock or multiple smaller paddocks?
- Do you have phone coverage across your property or is coverage limited?

Between all the suppliers offering on-animal sensor options, you should be able to find one that meets your needs. It is important to ask questions of suppliers as there are pros and cons to every sensor option and finding the one that best suits your herd, environment, and pocket is important.

Where to start?

If you are only just starting out, we suggest taking a moment to determine what it is you are wanting to get out of an on-animal system. Are you wanting it to identify livestock location, e.g. for improving mustering efficiency? Or are you wanting to use it to assist with health monitoring of your herd? Do you want a system that can do both?

Once you know what it is you want the system to do, we then suggest speaking to those companies that offer systems relevant to your needs, i.e. look for systems that use GPS/GIS if you want to locate your livestock and look for systems that use accelerometers if you want more in depth behavioural and monitoring information.

Supplier	Contact	Costs	Insights	Are they at Beef21?
Ceres Monitoring	www.cerestag.com/	Available to purchase May 2021		Ken Coombe Tech Yards
ioMonitoring	www.iotag.com.au/		Livestock tracking collar with GPS, accelerometer and ambient temperature thermometer. Battery life of 3 months	
mOOvement	www.moovement.co/	Pricing options vary. One off and yearly options available for individual units, network antennas, and data management systems	Cattle location ear tag with GPS. Built in solar panel for power. Requires on farm network	Ken Coombe Tech Yards
SmartBow	smartbow.com/en/	Available for purchase, but enquire online for more details.	Ear tag device to monitor rumination, heat detection and animal location. Suitable for intensive farming systems (ie feedlots)	
Smart Paddock	smartpaddock.com/	Available for purchase but enquire online for pricing.	Smart tags for GPS tracking of cattle, and more recently sheep.	Ken Coombe Tech Yards
Agersens	www.agersens.com	Priced per unit and software provided on monthly subscription. Can be scaled for larger installations. Enquire online for further information	Collar device for virtual fencing and animal monitoring.	Ken Coombe Tech Yards
Allflex	www.allflex.global/			R34

What questions should I ask?

- What features does this system provide? Is it just location information or can I get health/behaviour information?
- Is pricing a one-off cost or does it require a monthly/yearly subscription? Do I need to pay more for additional features?
- What infrastructure is required other than the eartag/collar device? Is this an additional cost?
- Is this system suitable for extensive grazing environments?
- How long do the units last? Are the batteries rechargeable?
- Do I have to tag all my animals or would a subset (e.g. 10% of the herd) be sufficient?
- How accurate is the information that is recorded? I.e. are animals within 10m or 100m of the recorded location?
- How often will I receive information?
- Can I access the system/information in the field on a smartphone or tablet? And will it work offline?
- Does the system integrate into any other farm management software?