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Preliminary investigation into the development of an electronic forage budget and land condition application, for use on existing hand-held devices, for the northern grazing industry

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Abstract

Within this project Agri-Science Queensland (within DEEDI) and Meat and Livestock Australia conducted a preliminary investigation into the viability, likely uptake and benefits of developing an 'app' (a software application hosted on a smart phone) to assist northern Australian graziers with their land condition monitoring and forage budgeting. Undertaking regular land condition assessments and forage budgets to match pasture supply to animal demand is considered part of best-practice management for graziers in northern Australia. Undertaking these management tasks, however, is often complex and requires a number of steps, both in the paddock and the office along with supporting tools and learnt skills to reach the end points; "what is the current condition of my pastures" and "how long will this feed last given the stock in the paddock". A specifically designed app for a smart phone or tablet was proposed as a potential solution to increase the adoption of these management practices amongst graziers. Three tasks were undertaken concurrently as part of the investigation; a review of literature, a survey of graziers and advisors in northern Australia, and consultation with software developers to scope the technical feasibility of developing the proposed app. The review of literature considered the evolution of hand-held decision support tools, a comparison of operating platforms and 'smart' devices for the task, and currently available agricultural apps and their uptake. A survey of northern Australian graziers and advisors sought views from industry what would be the likely benefit and uptake of this proposed app. The survey found that 76% of respondents thought this 'app' would be either useful or very useful for the grazing industry generally. Around 74% and 73% of respondents respectively said the app would increase the number or frequency of forage budgets and land condition assessments undertaken. Approximately 80% of respondents said the app would help them get started on forage budgeting and land condition assessments if they did not currently undertake these practices already. There are no technical constraints to developing the desired app and development costs were investigated. If development of an app proceeds, it will be important to provide a strong extension framework to support its piloting and promotion.

Executive summary

This project was undertaken to investigate the value and feasibility of developing a grazing land management application (app) for northern Australia using existing smart phone technology. The basis of the app would be the *Stocktake* land condition monitoring program. The feasibility of the app from both a technical perspective and in terms of cost-effectiveness was examined. The likely use of such a tool by producers and the likely impact of such a tool on industry's adoption of more proactive and effective grazing management were also investigated. A methodology for developing, piloting and promoting such a tool was outlined, should its development proceed.

This investigation was completed by undertaking a review of relevant literature, discussions with software developers and hardware specialists, consultation with producers and stakeholders involving a formal survey, and the interpretation and analysis of these findings.

In reviewing the literature, 2011 appeared to be the 'year of the app', where apps are being developed for all types of industries and for all sorts of purposes. Development of apps specific for agriculture has been lagging behind other industries although this is changing. A grazing management app has the potential to allow a land manager to integrate an existing mobile phone handset (a smart phone) with record keeping and decision support while in the paddock and in a time-efficient and convenient way.

In a survey of 125 people, comprising 91 producers and 34 land management advisors, 58% of respondents reported that they currently estimate and record land condition and ground cover percentages using a range of techniques. In the same survey, only 24% of respondents indicated that they complete a forage budget for all or some of their paddocks. Interestingly, some 22% of respondents currently own a smart phone or tablet with 64% of these devices using the Apple platform. Only 20% of these devices are currently using the Android platform.

Overall, 76% of the survey respondents thought the app would be either useful or very useful to the northern grazing industry. For those respondents currently not monitoring land condition, 78% said they the app would help them get started. For respondents currently not using forage budgets, 82% said the app would help them get started. The respondents perceived the main benefits of the app as:

- More informed stocking rate and land management decisions,
- Saving time on monitoring for either compliance or management, and
- Increasing the accuracy of management decisions.

Survey respondents were asked for the most important uses or features of the proposed app and the top three uses were:

1. Undertake a forage budget,
2. Assess/record land condition, and
3. Estimate ground cover.

Around 30% of survey respondents said the app should cost less than $50, however another 30% of respondents were willing to pay up to $100 for the app.

Some 65% of respondents said they would be keen to test the app as it is developed and 57% of respondents wanted to be notified when the app was ready.

In Australia, there exists several operating systems (platforms) which are capable of running a land management app based on the existing *Stocktake* program. Of the two most commonly used platforms, Apple and Android, it is recommended that the development of a land management app utilise the Apple or *iphone/ipad* platform. Differences in hardware

form factors, such as screen size and resolution, means it is often more complex to develop an app that will work reliably on all Android handsets. The Apple *iphone* is capable of running the proposed app and more importantly, unlike some smartphone handsets, has good telephone reception in regional and remote Australia.

It is important to understand that the majority of currently available apps are marketed as a tool that most users can download and use immediately in an effective way without the need for training or additional information. A well designed land management app should therefore allow the informed user to use the app as a management tool without the need for additional instructions or training. This will only occur if the app is visual, intuitive, has some inbuilt help mechanisms and the user can refer to web based assistance.

One of the original ideas was to examine the feasibility of developing two versions of the land management app; a basic version for use by graziers and a more elaborate version which incorporates other functions such as mapping, satellite imagery and biodiversity indicators into the basic version. As it is important to not overwhelm producers with overly complicated technology, it is recommended that the focus of app development be for servicing the priority needs of graziers, which is largely accommodated by the functions of the existing *Stocktake* program.

Developing a single version of the land management app that would assist all northern Australian producers to comply with their regulatory obligations is not currently feasible given the different land monitoring legislative requirements between States and even regions. This could change if a standard of monitoring equivalence was recognised by the different regulatory bodies. However, any tool that assists producers to monitor land condition and ground cover can currently help demonstrate proactive management to help address, but not necessarily fully meet, compliance requirements.

In researching this report, it was discovered that a software firm in Queensland in partnership with a Queensland grazier has already developed an app designed to assist graziers with their herd management. This app was released in August 2011 and it will be important to look at the possible merits of working in collaboration or in parallel with this app as there may be a number of opportunities where each app could complement the other.

With an estimated cost (development only) of around $120,000, the principal risks in developing a land management app are the uncertainties around (1) the level of uptake and (2) its impact on grazing management. The first represents a commercial risk which can be minimised by seeking collaborative partners, adapting and extending the app to southern Australia, and further negotiations with app developers. This development cost is not considered excessive when compared to development costs associated with other new technology such as remote area management systems. The second risk requires further assessment.

It is recommended that industry and its partners progress to a phase II of this project which would see a land management app developed, piloted and launched for use by the northern grazing industry. This should be by means of the Apple operating system, building a supporting web-based version of the app and, where appropriate, working closely with other relevant apps such as the recently released iHerd. The app should be considered an extension tool to be used within the broader FutureBeef Grazing Land Management program. If development of an app proceeds, a strong extension effort will be required to support its piloting, promotion and effective use by producers; this should include supporting e-tools (webinars, podcast, blogs) and workshops.

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1 Background

1.1 History

Currently there exists a number of paper and computer based tools for producers, RD&E personnel, Government compliance officers and advisors to perform forage budgets and monitor grazing land condition. In northern Australia, these tools include those associated with the GLM workshop, the *Stocktake* program, the DERM grazing *Environmental Risk Management Plan* and the *Delbessie* agreement. These existing products require a number of steps, both in the paddock and back in the office, using associated tools and techniques (land condition framework, ABCD land condition assessment, pasture photo standards etc) to answer the questions: "how long will this feed last given the stock in the paddock, desired cattle performance, and desired (or mandatory) ground cover levels?" and "what is the condition of this pasture?".

Not surprisingly, producers often find it very difficult to get started on forage budgeting and pasture condition assessment given the levels of complexity associated with bringing all the information, skills, tools and techniques together. Therefore, producers and their advisors may benefit from availability of a simple-to-use, integrated application, coupled to a suitable hand held device(s), which assists with forage budgeting and assessment of grazing land condition for both management and compliance purposes.

1.2 Scope

This project investigated the **viability, likely uptake and benefits of developing a software application** to assist users to assess land/pasture condition, ground cover and calculate forage budgets. The proposed application would need to be able to run on a range of available handheld devices (smart phone, tablets, etc) which can be operated by the majority of producers without intensive training. It was proposed to develop in parallel two versions of the application with the first version being a producer version while the second advanced version would be an upgrade, integrating additional functions, which would be of most use to RD&E personnel and advanced landholder users (such as pastoral company staff or those with a specific interest/need).

The focus of the producer version of the application was to be on a limited number of key indicators to increase the adoption of key grazing management practices; namely forage budgeting, estimating ground cover and assessing land/pasture condition. It is important for this version of the application to be a tool well suited to use in the paddock. The software application will need to include capacity for logically prompting the user to enter a field, tick the box, enter a number etc in a step by step process.

Decisions on stock numbers are also greatly influenced by the quality of the pasture and so the incorporation of forage/diet quality estimates (e.g., from faecal NIRS), and estimation of animal daily live weight gains, within the same integrated application, will also be investigated.

The device (an off-the-shelf product) hosting the application would require capacity to:

- store photo standards showing dry matter yield (kg/ha), ground cover (%) and land condition (ABCD framework)
- take and store photos
- record and store location (GPS).

The advanced application would need to incorporate 'add-ons' to the producer version which integrates such things as farm mapping programs, *VegMachine*, *1234 BioCondition* indicators and economic spreadsheets. Neither version of the application should be

dependent on real-time connectivity to the internet as in-paddock connection is not possible or is unreliable in many regions of northern Australia.

However, before initiating development of such an application, it was essential to thoroughly investigate the feasibility of doing so, its likely uptake, and its likely impact on industry's adoption of more proactive and effective grazing management.

2 Project objectives

2.1 Main objectives

By 30 September 2011, the project will have reported on the merits or otherwise of developing a user-friendly forage budget and land condition application (hosted by existing hand-held electronic device(s)) for real-time paddock use in northern Australia. This report was to include:

- Feasibility of developing such a tool from both a technical perspective and in terms of cost-effectiveness;
- The likely use of such a tool by producers, including those who are currently conducting 'formal' forage budgets and those who are not;
- The likely impact of such a tool on industry's adoption of more proactive and effective grazing management;
- The potential industry benefit of such a tool.

Contingent on the above, provide an outline of a methodology, time-line and budget for developing, piloting and promoting such a tool.

3 Methodology

The project methodology was split into four main areas in more or less the following order:

1. Review of literature
2. Confer with software developers and hardware specialists
3. Consultation with producers and industry stakeholders
4. Write up final report to meet project objectives and outcomes.

3.1 Review of literature

A search was made of the available literature related to smart phone and handheld monitoring technology and agricultural applications. Both the smart phone technology and the development of applications are changing rapidly; almost on a month by month basis. With this in mind, the most effective way of reviewing developments in this area was through the use of the worldwide web.

An app, short for application is a piece of software which can be run on the Internet, on a computer, or on a phone or other electronic device. Apps are designed to make a range of tasks easier and more convenient for the user. With smart phone technology being so efficient and portable, app users can complete a range of tasks anywhere at any time.

3.2 Confer with software developers and hardware specialists

A number of software developers in south east Queensland and one in Sydney were briefed on the proposed application. Meetings were held with 9 firms that specialise in the development of applications for smart phone technology. Two firms (Crunch Computers and Freshweb) were asked to estimate the cost of development based on varying levels of specification provided by our project team. The level of detail in the specifications varied depending on time and resources of the project team and software development companies.

3.3 Consultation with producers and industry stakeholders

A number of activities took place so as to make producers and stakeholders aware of the feasibility project and to also seek their views on the proposed application. All the Regional Beef Research Committees in north Australia were contacted and informed about this project. NRM groups and existing producer group and agency networks were also used to inform people about the project and gauge opinions on the app proposal.

3.1.1 Survey

In consultation with MLA, a questionnaire was developed seeking comment on the proposed application. The survey was set up using *Survey Monkey* (www.surveymonkey.com/). Producers and stakeholders were encouraged to complete the survey online, however paper copies of the survey were distributed at promotional activities. Some 125 surveys were completed, with 91 of the respondents (73%) being livestock producers. Survey questions are attached in Appendix 2.

3.1.2 Media releases

A media release was issued via the DEEDI media services. The media release was prepared to raise awareness of the project and direct people to the online survey. The project media release appeared in a number of publications and these are listed in Appendix
5. A number of radio interviews were also undertaken.

3.1.3 Field days

Project team members were able to present at a number of field days and meetings including information workshops in central Queensland organised by Agforce Projects, a land management seminar near Georgetown organised by the Northern Gulf Resource Management Group, and *Stocktake* workshops.

4 Results and discussion

4.1 Review of literature

4.1.1 Evolution of handheld decision-making tools

Historical studies of computer use in agriculture indicate that computers were used primarily as financial management tools rather than as production decision aids. Precision agriculture, which is a farming management system based on observing and responding to intra-field variations, relying on technologies like satellite imagery and information technology, has taken computer use beyond these established roles of financial accounting and record keeping. The evolution of Global Positioning Systems (GPS) into an on-farm tool has allowed spatial referencing of data. In agriculture, this has seen the development of portable computers to store this data so that it can be used to process spatially referenced crop, soil and other input data.

Research was undertaken to analyse farm and farmer characteristics that affect the adoption of Personal Digital Assistants (PDAs) and handheld computers with GPS capabilities in precision cotton production[1]. Data used for this analysis came from a 2005 survey where cotton producers responded providing information about the extent to which precision agricultural technologies were used on their farms as well as information on the general structure of their farming operations as well as perceptions about the future viability of precision agriculture.

[1] Walton, J.C. Larson, J.A. Roberts, R.K. Lambert, D.M. and English, B.C. (2008). PDA and handheld GPS adoption in precision cotton production. *Beltwide Cotton Conferences.* Nashville, Tennessee

The survey results indicated that adopters of PDA/handheld GPS devices had a relatively large farm size. Results also indicated that adopters tended to be younger, more educated, had greater income, and perceived extension services to be more helpful. Adopters also utilised computers in farm management applications to a greater extent than non-adopters. The authors contend that an understanding of the factors motivating adoption of a PDA/handheld GPS device in precision cotton production can provide insight into areas of potential improvement in the promotion of precision agriculture. Understanding the synergies among precision agricultural tools and practices that motivate adoption also has the potential to elucidate areas in which further product development could increase the efficiency of complementary products used in a package of precision farming technologies.

These results highlighted the importance of complementary relationships between PDA/handheld GPS use and other precision farming technologies and practices.

An application was developed to spatially survey insects and to facilitate the subsequent analysis of the collected data using a Geographic Information System (GIS)[2]. The device running the application was compact and light for field work and allowed collected information to be stored in one step to a normal computer. An essential step taken by the developers was to work closely with the potential end-user, in this instance, entomologists to write a list of requirements for the application. For example, the early requirements in this case included:

- The application user is an entomologist and his assistant,
- The application is easy to use,
- The application records both insects and the insect's host data,
- Data input is done by selecting predefined items,
- An editor is needed because the items sometimes change in the field,
- The application displays a map,
- The device works for at least 8 hours without the need for recharging.

The authors developed a specific application for use by entomologists, however the general approach taken in its development would be useful in developing any application. The developers commented that the application's open source was an advantage when some users required a greater number of items to be selected. Users are able to change strings in the interface at low cost so customising the application to their own needs. Open source was a good trade-off between customised and general use[3].

An essential step in developing an application is to work closely with the end user at all stages of development.

At the request of the cotton industry in Australia, an application was developed to be used on handheld devices based on existing pest management software (CottonLOGIC)[4]. The handheld devices used the Palm® operating system. Decision support systems are widely accepted in the Australian cotton industry for assisting with integrated pest management, crop nutrition and other aspects of information transfer and decision-making. Previously, cotton farmers and their consultants had to write the information they collected in the field on

[2] Otuka, A. and Yamanaka, T. (2003). An application for insect field surveys using a handheld computer. *Agricultural Information Research* , 113-124.

[3] Otuka, A. and Yamanaka, T. (2003). An application for insect field surveys using a handheld computer. *Agricultural Information Research* , 113-124.

[4] Bange, M.P. Deutscher, S.A. Larsen, D. Linsley, D. and Whiteside, S. . (2004). A handheld decision support system to facilitate improved insect pest management in Australian cotton systems. *Computers and Electronics in Agriculture.* , 131-147.

paper cards, and then copy this information to their desktop computers. Associated software was developed to manage the transfer of data between the handheld device and the existing *CottonLOGIC* desktop software. Its value to the users was established by extensive field testing and independent evaluation. The system helped with maintaining data integrity, consistency when there was more than one person collecting information, and time savings in collating information for pest management decisions using an IPM approach.

With the extensive adoption of cotton varieties such as Bollgard®, which have resistance to many insect pests, the use of software or applications for integrated pest management in cotton has effectively stopped[5].

The development of mobile devices and platforms for use in the European agricultural sector has been examined[6]. In the authors' opinion, the most important decisions to make at the start of any application development are the type of device and the operating system or operating platform to be used. The biggest constraint in the successful use of PDAs is screen size. According to the same authors, user performance drops as screen size decreases. Another important issue which has to be considered is the synchronization of data stored in handheld devices with a central database. This is inevitable because of the relatively small storage capacity of mobile devices.

The type of device, the operating system, screen size and synchronisation with a central database are all important elements in developing an application.

A handheld-based agricultural decision support system to help guide the efficient and economical management of nitrogen fertilizer application for wheat cropping in Australia was developed by a consortium involving the University of Melbourne and CSIRO[7]. The application allows farmers to electronically record soil and crop data, to retrieve in-situ meteorological data through wireless internet connection, to run and calibrate a series of widely-recognized regression-derived empirical and process-oriented biophysical models for agroecosystems, and to make practice decisions in the field for pursuing site-specific best management practices. The system included a handheld computer with wireless internet and a number of handheld-synchronized software applications. In this wheat model, crop images were closely monitored at different early growing stages by the built-in digital camera of the handheld computer to analyse the ground vegetation fraction (VF) by the handheld-installed software. With this VF, crop leaf area index and crop shoot density were estimated, then crop shoot density was related to soil nitrogen availability represented by crop nitrogen uptake. Given the optimal crop nitrogen uptake at different growing stages, a decision on necessary nitrogen fertilization was made in-situ in the paddock.

A combination of internet and cellular phone technologies was used to develop a crop information system for agricultural field work in remote areas of Sri Lanka[8]. This system was used to provide the latest agricultural information to assist decisions made around crop production, disease, variety, pesticide, irrigation and harvesting issues. The same system was used as a simple and portable application to remind workers about timely field operations. Apparently even remote areas of Sri Lanka have access to cellular phone signal.

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[5] Bange, Mike 2011, pers. comm.

[6] Szilágyi, R. Herdon, M. and Lengyel, P. (2005). Agricultural application development for mobile devices. University of Debrecen, Hungary.

[7] Yong, L. (2007). Handheld-Based Agricultural Decision Support System for Advising Efficient Nitrogen Utilization for Wheat Cropping. *American Society of Agronomy*, (pp. 348-353). New Orleans, Louisiana.

[8] Jayasinghe, P.K.S.C. Yoshida, M. Machida, T. (2009). An Agricultural Field work Management System for Rural Farmers in Sri Lanka. *7th World Congress on Computers in Agriculture*., (pp. 4-9). Reno, Nevada.

To develop this system, MS Access database, ASP, HTML, VBScript, IIS web server and WAP technology were employed.

Being able to use specialised applications for several tasks such as listing jobs to do provides a multi-purpose function to the application which may increase its appeal to users.

A number of researchers who work at Information Services Unit, International Center for Tropical Agriculture in Cali, Colombia developed a wireless system such that researchers isolated from their main offices could record data in the field and electronically transfer this data to their respective research facilities[9]. The researchers would lose valuable time in manually collecting field data, and transcribing and processing the data back in their laboratories and offices—steps that increased the risk of error. The authors first studied their researchers' needs and explored the state of the art in wireless technology, focusing on outdoor solutions and services offered. They took into account such factors as researchers' work environment, processing of collected data, conditions under which researchers collect data (e.g., with one or both hands), and the time they typically needed to connect with information systems. Their next step was to construct a prototype of wireless mobile technology, focusing first on achieving on-campus connectivity as it relied less on third-party service providers.

A common problem in data capture for germplasm evaluation assays in Colombia was the accurate identification of diseases, insects, and unconventional problems shown by plants. The application allowed the researcher to consult a grass and legume species database online to confirm the presence of a disease, insect, or nutritional problem, and to identify it with the help of textual information or reference images[10]. The following images (Figure 1) are examples of the screenshots used in the application for this purpose.

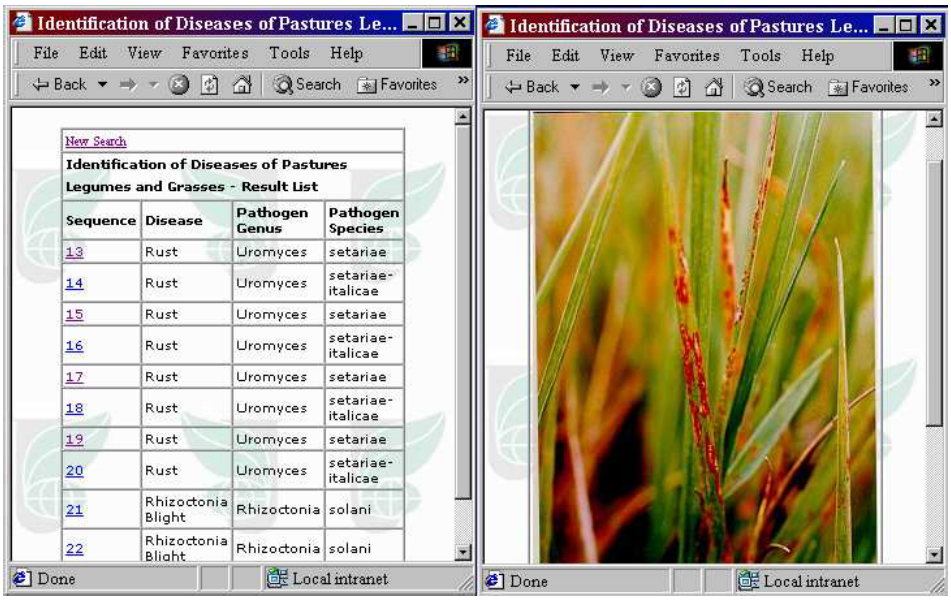

Figure 1. Example screenshots used in application (disease identification) developed by International Center for Tropical Agriculture in Colombia. Source: (Meneses, C.B. Grau, R. and Garces, J. 2005)

[9] Meneses, C.B. Grau, R. and Garces, J. (2005). The use of wireless technology in tropical agriculture research field work. Cali, Colombia.

[10] Meneses, C.B. Grau, R. and Garces, J. (2005). The use of wireless technology in tropical agriculture research field work. Cali, Colombia.

A major goal in developing this application was to use predesigned, online field books to capture data in digital form directly from field sites while accessing existing information in the databases. The digital field books replaced paper books, thus reducing time and errors in data capture, and permitting real-time updating of the databases. The following images (Figure 2) are examples of screens used for this application.

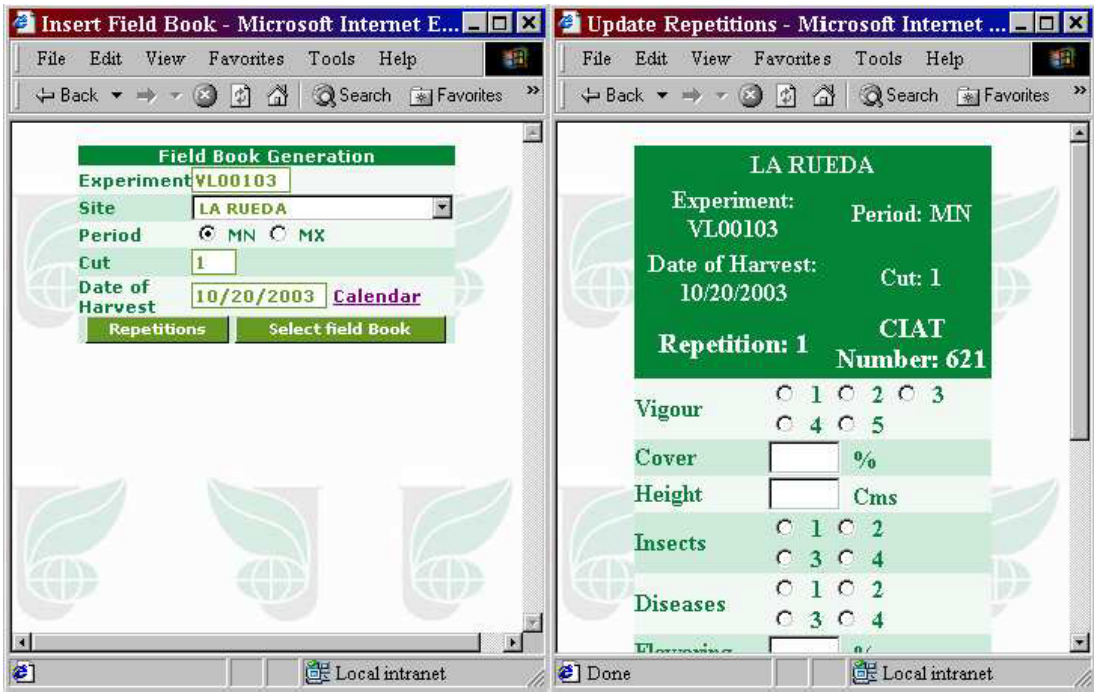

Figure 2. Example screenshots used in application (field book) developed by International Center for Tropical Agriculture in Colombia. Source: (Meneses, C.B. Grau, R. and Garces, J. 2005)

Interestingly, the developers discovered that rather than buildings and other infrastructure obstructing mobile coverage, they found that trees were far more disruptive than walls. The effectiveness of wireless technology can be improved by using complementary input devices, such as digital cameras or bar code scanners. In 2005, the authors found it difficult to find handheld devices that provided a convenient development platform, were resistant to environmental hazards and came with sufficient energy backup for a normal workday. At the end of their development phase, the authors tested the device and application against a "technology acceptance model and diffusion of innovation framework". The results of this testing included:

- A relative advantage being granted by reducing errors and more efficient use of time,
- Compatibility, thanks to using the same databases and similar interfaces. However, researchers must get used to a new kind of interface (the handheld device),
- Complexity is reduced by designing interfaces that are easy to use and understand, and trying to ensure that users can do all they need with just one type of device,
- 'Trial-ability' thanks to the demonstration or pilot applications created,
- 'Observe-ability', that is, partners and third parties see increased efficiency and, at least potential for, greater sharing of systems,
- Image, as wireless technology is currently one of the "hottest" communication technologies and is likely to remain so in the foreseeable future,
- Trust, because the researchers were actively working to reduce errors.

Resistance to environmental hazards and sufficient power for normal working conditions are important design features when selecting handheld devices.

It has been observed that traditional tools for recording animal behaviour are relatively expensive and require the purchase of separate mobile computers to enable field observation[11]. An alternative system has recently become available as a cheap app for Apple I-Phone, I-pod and I-pad devices. The behavioural observation app *WhatIsee* is available for less than $20 and can be used on the *Ipod touch* device costing around $250, which is substantially cheaper than traditional alternatives. The quantitative description of an animal's behaviour is simply entered into the touch interface and monitoring can be undertaken as a continuous or discreet process. Data is collected as a text string (.csv file). Data output is achieved by connection to wifi network for I-pod touch. Using *WhatIsee* on the Apple I-phone allows integrated GPS enabled geo-referencing of the records. This has potential for confirming the distance between observer and the subject being observed if this is critical. Furthermore the GPS enabled the I-phone to function as a simple geo-referencing field device for other data for example pasture species mapping.

An example of the scope of apps and one with some rural connections comes from Tasmania. The Tasmanian Parks and Wildlife Service has combined with a spatial and web- mapping products firm, Geometry, and some of Tasmania's photographers and sound recordists to produce an app on some of Tasmania's birds. The app called *A bird in the hand*, covers 23 of Tasmania's common and endemic birds and includes bird calls, high quality pictures and information on their habitat, breeding and diet. The app can be used while in the bush to attract birds and also to work out which call is which. A sample screen appears below (Figure 3). The app is for sale through Apple for around $1.20 and takes up 23 Mb of memory.

Figure 3. Sample screenshot from "A bird in the hand" app. Source: (Geometry - Building Intelligent Business 2008).

[11] Trotter, M. (2010). New tools in spatio-temporal grazing systems research. *1st Australian and New Zealand Spatially Enabled Livestock Management Symposium.* (p. 10). Armidale: Precision Agriculture Research Group, University of New England, Armidale, Australia.

In an article about a young, progressive cotton farmer (Zach Sheely) in California praises the touch screen technology of the Apple *iPhone* and *iPad*[12]. The New York Times predicts *iPads* and copycat tablet computers will be the fastest-adopted technology in the history of digital devices. The projection is for *iPad* sales to reach 28 million this year, and by 2012 more than 63 million sales. Working with a computer programmer, an aerial imagery provider and an irrigation management company, Sheely is developing a pictorial *iPad* and *iPhone* app, named *SiteToDo* that will not only provide information about what is happening on a farm and what needs to be done, but will connect a farm's management team on a real- time basis. it is reported to be a simple spatial to-do application, which will allow farmers to geo-tag tasks on a map on a touch-screen[13]. Tasks can be reviewed, created and changed. Sheely makes the comment that many computers and software programs are not farmer friendly and certainly not sufficiently intuitive.

It is important for an application to be farmer friendly and sufficiently intuitive.

Sheely developed the *SiteToDo* app for Apple using iOS because he regards it as a stable operating system and it is very convenient to download an app wherever you are and there is no learning curve for anyone picking up the Apple platform. He understands well that farmers want to spend as little time as possible in an office on a computer — they want to be in the paddock and have simple, instant access to information on the go. Sheely and his associates asked one group of farmers and consultants how many had *iPhones*, and 15 percent did. Another 15 percent had Androids and 10 percent had *BlackBerrys*. The other 60 percent said they were anticipating buying an *iPhone* or *iPad* or something similar to the Apple platform within the next year. He believes this is a good indication of how demand for tablet computer apps like *SiteToDo* will grow.

The app can also track moving targets using GPS. Sheely said that he is able to see where everyone is on the farm at any one time. If you want someone to meet you at a particular spot, each user can see on the screen where the other is located and then go directly to the meeting spot. Everything a *SiteToDo* user can do on the farm, he can also do remotely off the farm by using the mobile telephone system. In the United States, an iPad2 price starts at US$500, has 10 hours of battery life, and can be plugged into a vehicle's lighter socket to keep the battery fully charged[14]. The highest capacity unit sells for about US$800; with accessories like a case and keyboard with the total cost around US$1,000. With a rubberized case, the *iPad* is durable. Sheely also believes the technology, in particular tablet technology will attract more young people into farming. "Agriculture gets a bad rap in the media," says Sheely and. "maybe if we can tell how we're using technology that the public understands, it could help us educate them about farming."

4.1.2 Smartphones and other devices

A smartphone is a mobile phone that offers more advanced computing ability and connectivity than a contemporary feature phone (low end mobile phone). Smartphones and feature phones may be thought of as handheld computers integrated with a mobile telephone, but while most feature phones are able to run applications based on platforms such as Java ME, a smartphone allows the user to run and multitask applications that are native to the underlying hardware. Smartphones run complete operating system software providing a platform for application developers. Thus, they combine the functions of a camera phone, a personal digital assistant (PDA) and often a GPS.

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[12] Cliine, H. (2011, April). Apple apps coming to agriculture. *Agricultural Technology/Irrigation* , pp. 10-11.

[13] Cliine, H. (2011, April). Apple apps coming to agriculture. *Agricultural Technology/Irrigation* , pp. 10-11.

[14] Cliine, H. (2011, April). Apple apps coming to agriculture. *Agricultural Technology/Irrigation* , pp. 10-11.

A tablet computer, or simply tablet, is a complete mobile computer, larger than a mobile phone or personal digital assistant, integrated into a flat touch screen and primarily operated by touching the screen. It often uses an onscreen virtual keyboard or a digital pen rather than a physical keyboard. The tablet computer market was invigorated by Apple through the introduction of the *iPad* device in 2010. While the *iPad* places restrictions on the owner to install software thus deviating it from the PC tradition, its attention to detail for the touch interface is considered a milestone in the history of the development of the tablet computer.

A key and common component among tablet computers is touch input. This allows the user to navigate easily and intuitively and type with a virtual keyboard on the screen.

According to an Olswang report, in early 2011 smartphones were experiencing accelerating rates of adoption: 22% of UK consumers already have a smartphone, with this percentage rising to 31% amongst 24-35 year olds. (Olswang is a leading European business law firm with a reputation in the technology and media sectors.) Growth in demand for advanced mobile devices boasting powerful processors, abundant memory, larger screens, and open operating systems has outpaced the rest of the mobile phone market for several years.

In February 2011 Nokia announced a plan to make Microsoft Windows Phone 7 its high end smartphone operating system, reducing the existing MeeGo to a research platform while still keeping Symbian for mid range and low range products. In 2007, Apple Inc. introduced its first *iPhone*. Initially lacking the capability to execute and multitask native applications, many reviewers considered the originally-released device to be more akin to a feature phone than a smartphone. It was one of the first mobile phones to be mainly controlled through a touchscreen. It was the first mobile phone to use a multi-touch interface, and it featured a web browser that was then described as far superior to anything offered by that of its competitors. A process called jailbreaking emerged quickly to provide unofficial third-party applications.

In July 2008, Apple introduced its second generation *iPhone* with 3G support. At the same time, Apple created the App Store with both free and paid applications. The App Store can deliver applications developed by third parties directly to the *iPhone* or *iPod Touch* over Wi-Fi or mobile network without using a PC to download. With the introduction of the App Store, the *iPhone* gained a key smartphone feature that it lacked, i.e. the capability to install and execute native applications. The App Store has been a huge success for Apple and by April 2010 hosted more than 185,000 applications[15]. The App Store hit three billion application downloads in early January 2010, and 10 billion by January 2011. In June of 2010, Apple introduced multitasking capability to iOS, which is the second key smartphone feature that it lacked.

As earlier discussed, the Android operating system for smartphones was released in 2007. Android supports the execution of native applications and a pre-emptive multitasking capability. Third-party apps are available via the Android Market (released October 2008), including both free and paid apps.

In the fourth quarter of 2010, Android surpassed Symbian as the most common operating system in smartphones, with 32.9 million units sold versus 31.0 million worldwide. Android-equipped phones sold seven times more in 2010 than in 2009 due to customers' increased preference for a device that can access websites while bypassing traditional computers. Platforms other than the *iPhone* are able to download apps from any website, rather than only from a single app store; however, other companies have more recently launched their own app stores. Google launched the Android Market in October 2008. RIM launched its app

[15] Wikipedia. (2011, May 28). *iOS Apple*. Retrieved May 2011, from http://en.wikipedia.org/wiki/IOS_(Apple)

store, BlackBerry App World, in April 2009. Nokia launched its Ovi Store in May 2009. Palm launched its Palm App Catalog in June 2009. Microsoft launched its Windows Marketplace for Mobile in October 2009. Amazon launched its Android Appstore in early 2011.

The year 2010 saw the rapid rise of the Google Android operating system from 4 percent of new deployments in 2009 to 33 percent at the beginning of 2011 making it share the top position with the since long dominating Symbian OS.

There are currently over 150,000 apps available for Android. Android Market is the online app store run by Google, though apps can also be downloaded from third-party sites. Developers write primarily in the Java language, controlling the device via Google-developed Java libraries. An app called *Market* is preinstalled on most Android devices and allows users to browse and download apps published by third-party developers, hosted on Android Market[16].

In an article titled "10 Things Android Does Better Than *iPhone OS*", the following comparisons are made:

- Android can run multiple tasks at the same time whereas *iPhone* can only perform a limited number of tasks at any one time,
- Android keeps information visible on your home screen. One of the key features Android has is a customizable home screen which keeps active widgets right at your fingertips (finger swipe), always accessible and always visible - without having to launch an application first. Meanwhile *iPhone* users need to flip through their app list to locate and launch each app.
- Android has a better app market, although it is true that Apple's App Store has over 180,000 applications, while the Android Marketplace has only just broken the 50,000 mark. But Android's rapid growth and adoption give it the potential to catch up to the *iPhone* App Store. Android also has another advantage, i.e. a completely open market.
- Android gives better notifications. The *iPhone* has some trouble with notifications. Because it's restricted to pop-up notifications, it can only handle one at a time and because it lacks multitasking, applications must be open in order for them to receive notifications. Android, on the other hand, has a convenient notification bar which displays an icon for every notification you have waiting.
- Android lets you choose your hardware. Apple users do not get much choice when it comes to the actual hardware. Other than being able to choose the colour and the memory of the device, users are limited to the Apple devices. Because Android is an open platform, manufacturers have the freedom to pair it with any hardware[17].

Similarly, in another comparison of operating systems, the following points were made:

- *iPhones* are expensive and often costly to repair if they break.
- BlackBerry devices don't have access to as many apps as *iPhones*.
- Android is a powerful piece of software and can be tweaked to your own specifications and wants.
- Android devices aren't necessarily carrying the same software versions and incompatibility can be a problem. Android gadgets are also somewhat complex to navigate.
- Windows 7 Phone is the easiest of the software packages to navigate.

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[16] Wikipedia. (2011, March 30 th). *Android OS*. Retrieved May 2011, from http://en.wikipedia.org/wiki/Android_(operating_system)

[17] Escallier, P. (2010, June). *10 things Andrroid does better than iphone OS.* Retrieved April 2011, from MaximumPC: http://www.maximumpc.com/user/author1

- Symbian is Nokia's operating system of choice and is quickly losing market share. However Nokia is developing a new operating system soon[18].

The choice of operating system usually comes down to two main issues - the `look and feel' of the phone and its applications (apps) capability. It's the OS technology that decides how you will actually physically interface with your smartphone (some are easier than others), and secondly, and more importantly for some people, the OS software dictates which apps you can download. There are thousands of apps to buy or get for free, but not all apps work on all phones. However, app design is changing rapidly and many applications like the *Amazon Kindle e-reader* app are now designed to work on Google's Android OS as well as iOS, plus Windows Mobile 7[19].

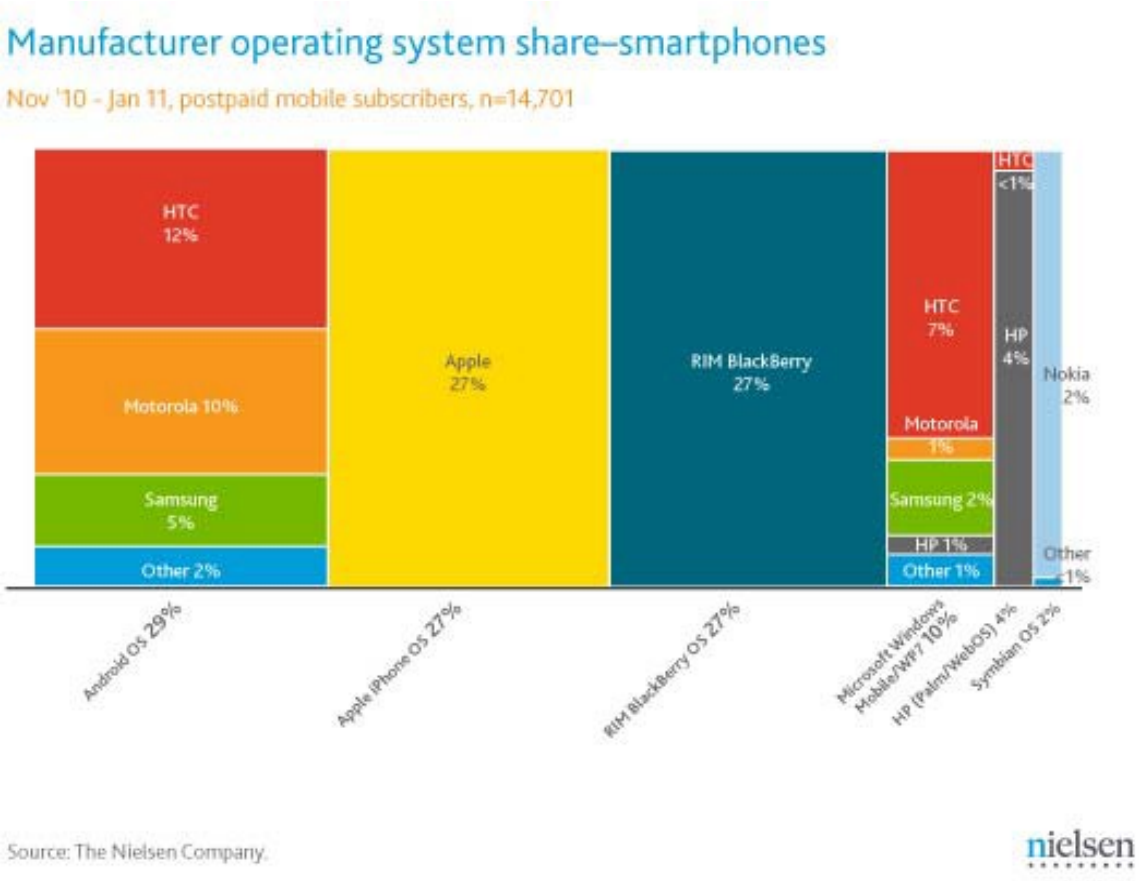

Figure 4. Manufacturer operating system share in the US - smartphones. Source: (The Nielsen Company 2011).

[18] Stafford, P. (2010, October 12). *Startupsmart*. Retrieved 2011, from http://www.startupsmart.com.au/growth/innovation/2010-10-12/understand-smartphone-operating-systems.html

[19] Anny. (2011, February 2). *Smartphone buying guide*. Retrieved June 2011, from http://blogs.lasoo.com.au/2011/02/smartphone-buying-guide/

In Australia, market research by The Nielsen Company shows the smartphone operating systems market share figures for the first quarter of 2011[20]. Figure 4 shows that that the Android platform has risen to the top of market share.

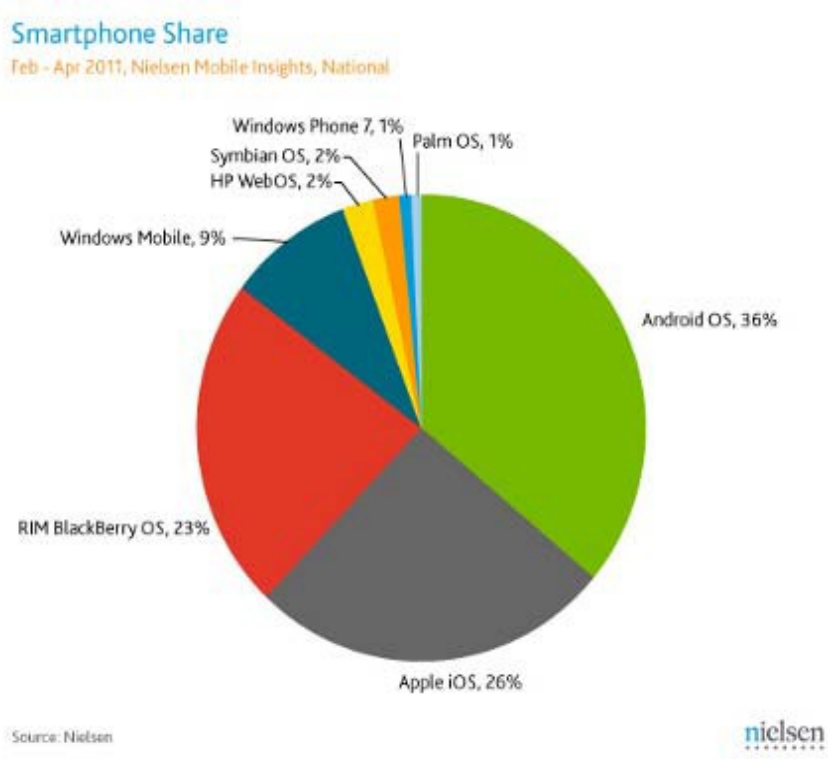

Figure 5. Australian smartphone operating system market share at February-April 2011.Source: (Conneally, T. 2011).

The changes in market share as cited by The Nielsen Company point to a growing popularity in the Android operating system, largely at the expense of the RIM Blackberry and MS Windows Mobile operating systems[21]. See Figure 5 and Table 1. These changes would be in most part related to the marketing power of the mobile phone carriers and providers, and how attractive the actual smartphone device is to the consumer. The majority of consumers would not be buying on the pros and cons of each operating system.

Table 1. Changes in Australian market share of smartphone operating systems. Source: (Conneally, T. 2011)

Operating system	February-April 2010	February-April 2011	Annual change
Android	9%	36%	+27%
Apple iOS	28%	26%	-2%
MS Windows Mobile	19%	9%	-10%
RIM Blackberry	35%	23%	-22%

A critical issue in selecting a handset/operating system to use is available memory. For example the *iPhone* 4 has an internal memory of 16 GB or 32 GB, whereas the latest

[20] Conneally, T. (2011, June 2). *Android dominates smartphone market but consumes tons of data*. Retrieved June 2011, from http://au.ibtimes.com/articles/155981/20110602/android-dominates-smartphone-market-but-consumes-tons-of-data.htm

[21] Conneally, T. (2011, June 2). *Android dominates smartphone market but consumes tons of data*. Retrieved June 2011, from http://au.ibtimes.com/articles/155981/20110602/android-dominates-smartphone-market-but-consumes-tons-of-data.htm

Android handset, the HTC Desire S has an internal memory of only 1.1 G. In contrast, the *iPhone* 4 does not have an option for expandable memory, whereas the HTC Desire S has a microSD card slot for additional memory[22].

The development of any land management app will need to consider the memory capacity of different handsets.

With the models of handsets for both *iPhone* and Android changing at least annually, the features of phones will need to be assessed on a continual basis. For example, during 2011, the *iPhone's iOS* 4.0 will be released including features like *iBooks*, folders, games, camera zoom, multitasking and tethering. Tethering is the use of a mobile phone as a modem for another device, usually a notebook or PDA. The connection is made either with a cable (USB or serial) or wirelessly through bluetooth. Android 2.2 or *Froyo* is also due to be launched on an array of phones including features such as tethering, multitasking, and even Flash support.

4.1.3 Comparing operating systems or platforms

4.1.3.1 Worldwide

A mobile operating system, also known as a mobile OS, a mobile platform, or a handheld operating system, is the operating system that controls a mobile device or information appliance—similar in principle to an operating system such as Windows, Mac OS, or Linux that controls a desktop computer or laptop. However, mobile OS are currently somewhat simpler, and deal more with the wireless versions of broadband and local connectivity, mobile multimedia formats, and different input methods[23]. Typical examples of devices running a mobile operating system are smartphones, personal digital assistants (PDAs), tablet computers and information appliances, or what are sometimes referred to as smart devices.

The increasing importance of mobile devices has triggered enormous competition amongst software giants such as Google, Microsoft, and Apple, as well as mobile industry leaders Nokia, Research In Motion (RIM), and Palm, in a bid to capture the largest market share. With the release of the *iPhone* in 2007, Apple ushered in a new era of smartphone operating systems that focus on user experience and rely on touch-based interaction. In November 2007, Google formed the Open Handset Alliance with 79 other hardware, software, and telecom companies to make inroads into the smartphone market through its new Android operating system. Since the launch of both Apple's iOS and Google's Android, the smartphone market has rapidly expanded and in May 2010, accounted for more than 17.3% of all mobile phones sold[24].

Operating systems that can be found on smartphones include Nokia's Symbian, Google's Android, Apple's iOS, RIM's BlackBerry OS, Microsoft's Windows Phone, Linux, HP's webOS, Samsung's Bada, Nokia's Maemo and MeeGo among many others. Android, Bada, WebOS and Maemo are built on top of Linux, and iOS is derived from the BSD and NeXTSTEP operating systems, which are all related to Unix.

The most common operating systems used in smartphones by worldwide 2010 sales are:

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[22] Catanzariti, R. (2011, March 1). *HTC Desire S vs Apple iPhone 4: Smartphone showdown*. Retrieved June 2011, from http:www.best of\Apple vs Android phone comparison.mht

[23] Wikipeida. (2011, May 28). *Mobile Operating System*. Retrieved June 2011, from http://en.wikipedia.org/wiki/Mobile operating_system

[24] Wikipedia. (2011, May 25). *Smartphone.* Retrieved June 2011, from http://en.wikipedia.org/wiki/Smartphone

1. The Symbian OS from the Symbian Foundation (open public license)
2. Android OS from Google Inc. (open source, Apache).
3. The iOS from Apple Inc.(closed source, proprietary).
4. RIM BlackBerry OS (closed source, proprietary)
5. Windows Phone OS from Microsoft (closed source, proprietary).

Android was developed by a small start-up company that was purchased by Google Inc., and Google continues to update the software. Android is an open source, Linux-derived platform backed by Google, along with major hardware and software developers (such as Intel, HTC, ARM, Samsung, Motorola and eBay), that form the Open Handset Alliance. Released on November 5th 2007, the OS has a following among programmers. There have been seven releases of Android- Android 1.0, 1.5, 1.6, 2.0, 2.1, 2.2 and 2.3. All are nicknamed after a dessert item like Cupcake (1.5) or Frozen Yogurt (2.2). Most major mobile service providers carry an Android device. There has been an explosion in the number of devices that carry Android OS. From the second quarter of 2009 to the second quarter of 2010, Android's worldwide market share rose from less than 5% to around 20% (Table 2). In first quarter of 2011, the Android OS has the largest share of the worldwide market.

The worldwide market share for the Android operating system has grown markedly in the last three years, while the share held by the Symbian and Blackberry RIM operating systems has declined.

The Apple *iPhone, iPod Touch* and *iPad* all use an operating system called iOS, which is derived from Mac OS X. Third party applications were not officially supported until the release of iOS 2.0 on July 11th 2008. Before this, jailbreaking allowed third party applications to be installed, and this method is still available. (Jailbreaking is the act of exploiting a bug, design flaw or configuration oversight in an operating system or software application to gain elevated access to resources that are normally protected from an application or user.) Currently all iOS devices are developed by Apple and manufactured by Foxconn or another of Apple's partners.

The RIM BlackBerry OS has focused on easy operation and was originally designed for business. Recently it has seen a surge in third-party applications and has been improved to offer full multimedia support. Currently Blackberry's App World has over 15,000 downloadable applications.

On 15 February 2010 Microsoft unveiled its next-generation mobile OS, Windows Phone 7. The new mobile OS includes full integration of Microsoft services such as Windows Live, Zune, Xbox Live and Bing, but also integrates with many other non-Microsoft services such as Facebook and Google accounts.

Table 2. Worldwide market share by operating system (Gartner Inc [a]) Source: (Wikipeida 2011)

Year (first quarter)	Symbian	Android	RIM	iOS	Microsoft Mobile 7	Other OSs
2011	27.4%	36.0%	12.9%	16.8%	3.6%	3.3%
2010	37.6%	22.7%	16.0%	15.7%	4.2%	3.8%
2009	46.9%	3.9%	19.9%	14.4%	8.7%	6.1%
2008	52.4%	0.5%	16.6%	8.2%	11.8%	10.5%
2007	63.5%	N/A	9.6%	2.7%	12.0%	12.1%

Table 3 provides a comparison of the current smartphone operating systems.

Table 3. Comparison of smartphone operating systems (latest versions at May 2011)

Feature	iOS	Android	Windows Phone	Blackberry	Symbian
Company	Apple	Open Handset Alliance(Google)	Microsoft	RIM	Symbian Foundation
Current version	4.3.3	3.1	7.0.7392.0	6.0.0	9.5
OS family	Mac OS X/Unix-like	Linux	Windows CE 7	Mobile OS	Mobile OS
Supported CPU architecture	ARM	ARM, MIPS, Power Architecture, x86	ARM	ARM	ARM
Programmed in	C, C++, Objective-C	C, C++, Java	Many NET (Silverlight/XNA)	Java	C++
License	Proprietary EULA except for open source components	Free and open source (Android 2.3.4) and closed source (Android 3.0.1)	Proprietary	Proprietary	Eclipse Public License
Public issues list	No, but there is a unofficial tracker	Yes	No, but there is a unofficial collection	No	Not anymore
Search multiple internal applications at once	Yes	Calendar has no search	No	Yes	Yes
Desktop sync	Yes	No	No	Yes	Yes
Local full backup	Yes	No	No	Yes	Yes
Cut, copy, and paste	Yes	Yes	Yes	Yes	Yes
Undo	Yes	No	No	No	?
Text/document support	Read only: Microsoft Office, iWork, PDF, Images, TXT/RTF, VCF		Microsoft Office Mobile, PDF	Microsoft Office, PDF	Microsoft Office Mobile, PDF,djvu
Multitasking	Limited	Yes	Tombstoning	Yes	Yes

Source: (Wikipeida 2011)

There is wide spread criticism of poor reliability in obtaining systems updates for Android phones, i.e. updates are either slow to receive or fail to get to the phone. The process of getting an update ready to push to a handset is logistically difficult[25]. The process outlined is:

1. Google creates, tests and releases a system update.
2. Handset manufacturers take the system update and apply their vendor-specific tweaks to it, then test it on their various devices.
3. Carriers then test the update, certify it, and push it out to the handsets.

Mix in the fact that the average Android handset manufacturer seems to release 5-10 devices over a 12-24 month period and you can start to imagine the logistics involved in this process. We can clearly see an 'ecosystem' that simply cannot properly provide long- term support for system updates to Android handsets (as it currently exists). It's not due to malice it's just not practical[26]. If the process is allowed to continue, system updates including updates to apps will be slow and specific to each type of Android handset.

In contrast, although Apple are also renowned for being slow to release updates, they are reputed to have few problems and their handsets generally receive updates without glitches. The difference is that Apple controls all steps of the process and does not have to customise updates and apps to work in different handsets. Lack of choice in handsets is an issue for some users, particularly if a particular handset has better reception.

The inflexibility of the Apple software is often listed as a weakness for Apple. There is very little tweaking and customization allowed by the Apple operating system. According to one commentator, you have to do it Apple's way or else it's probably not an option[27]. These limits allow Apple products to function very well within the protected space carved out by Apple. However, inflexibility can limit options if you have the need or desire to do something that is not within the boundaries Apple has set and can't create an app to handle it. In addition, the operating system itself is not especially tailored for multi-tasking or work-focused tasks such as building presentations, editing files, and juggling several bits of information at once.

Many of the people working in the smartphone industry relate what we are seeing today to be like the old Microsoft vs. Apple battle of yesteryear[28]. Apple has a stranglehold on developers now, however as the Android market grows, the number of developers working with the Android platform will also grow. This does not factor in that developers are obliged to give 30% of returns to Google as required by Apple. Every year Google is tackling some of the biggest problems their platform suffers from. This year, they are addressing the concerns of fragmentation and update cycles.

4.1.3.2 Platforms in Australia

For an Australian perspective, discussions were held with Mr Tim Webber who is with Telstra's technical innovation and marketing division. With the proviso that the market will dictate which handsets and which operating systems will be taken up by the Australian market, the overriding factor for users of the proposed land management app will be 'can my handset pick up a mobile signal on the farm or near where I live"[29]. (Telstra is recognised as

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[25] King, A. (2011, March 8). *The Android OS Update Problem*. Retrieved June 2011, from http://www.alexking.org

[26] King, A. (2011, March 8). *The Android OS Update Problem*. Retrieved June 2011, from http://www.alexking.org

[27] Hiner, J. (2011, January 18). *Android vs. Apple: The 2011 cage match*. Retrieved June 2011, from http://www.ZDNet.mht

[28] Paultre, G. (2011, May 16). *Google/Android versus Apple/iPhone. What are the possible outcomes between these powerhouses?* Retrieved June 2011, from http://www.quora.com/Gaetan-Paultre

[29] Webber, T. 2011, pers. comm.

the mobile phone carrier with the most reliable coverage of the 3G network in rural and regional Australia.) Generally producers acquiring a new handset will ask the retailer if the device has the 'blue tick', meaning it has the best available coverage in rural Australia.

Reliable network coverage is a significant point of differentiation in the Australian market for smart phone platforms and handsets. This is particularly prevalent in rural and remote areas.

Currently there are a number of handsets using the Android platform which have the blue tick. The Apple *iPhone 4* is also given the blue tick by Telstra provided it is used in a protective case which insulates the phone from hand contact. If the *iPhone 4* is used without its case, the phone is downgraded from 'C' 3G coverage to 'B' 3G coverage. 'C' coverage is equivalent to the blue tick, 'B' coverage is suitable for regional centres, and 'A' coverage is suitable for urban use. Given the public outcry with the insulation issues surrounding the issue of the *iPhone 4*, it is likely that Apple will rectify this problem and in fact improve their receptivity.

The Apple and Android operating systems will continue to expand in Australia at the expense of the Blackberry RIM and Nokia Symbian operating systems[30]. Nokia is phasing out their relationship with the Symbian platform and has partnered with Windows to produce the Windows Phone 7 operating system. The latter system was only launched in 2010 and has not gained any real market share to date.

Using Apple handsets and their operating system restricts the consumer's choice, i.e. the user buys the same phone as everyone else using the same operating system. This is in contrast to Google who market the Android operating system in a wide variety of handsets which in turn are supplied by numerous mobile phone carriers. Because the Android handsets vary in 'hardware form factors', e.g. screen resolution, often the same app will not work, or will work differently, on different handsets. The same issues can materialise when the app developer makes available a newer version of an existing app.

The result of these differences in hardware form factors is that it is often more complex to develop an app that will work reliably on all Android handsets.

In Australia, currently Apple has the largest penetration into the smartphone market with their *iPhone* and this is likely to continue. When looking at overseas uptake of operating systems where in many countries Android is outselling Apple, it should be recognised that this can be dependent on which handsets are being marketed by the various mobile phone carriers[31]. Another factor is the relatively good mobile coverage in say the USA and in European countries which means reliable coverage in remote areas does not have the same significance as it does in Australia. In some countries where mobile phone technology is more advanced, consumers are looking for choice in handset functionality, appearance and phone plans which will vary between handsets and carriers.

1.1.1 Currently available agricultural applications (apps)

An agricultural app available through iTunes is designed for arable farmers and professional agronomists in the United Kingdom advising on oilseed crops. It allows the user to determine the Green Area Index of the crop from a photograph. The App is marketed by BASF and called OSR GAI and is listed for sale at $2.99. Figure 6 shows screenshots of this app. The online version, with a more complete set of reference photos can be found at www.totaloilseedcare.co.uk.

[30] Webber, T. 2011, pers. comm.
[31] Webber, T. 2011, pers. comm.

Figure 6. Screenshots from OSR GAI app marketed by BASF Source: (iTunes Preview 2011).

An Australian joint venture between farmers, Peter Macdougall and Adrian Lyons, and builder David Campbell, has released an *iPhone/iPad* software application to support agronomists, called *ESIApp*. The company is readying the release of an app to support recording of on-farm spray applications, and later in 2011 plans to release a multi-tasking *Farmers App* with the objective of replacing the ubiquitous farmer's pocket notebook.

It seems the inspiration for the app came from David Campbell's building background. Rather than driving to sites to assess, record and troubleshoot the many facets of a building project, his foremen and contract electricians use their *iPhone*s or *iPads* to report site movements, material requirements, deliveries and non-deliveries, and progress status[32].

Grazier Peter Macdougall, from Crookwell in central NSW, who forms a third of *ESIApp* venture claims the *Agro* app removes the need for a paper trail for agronomists[33]. The agronomist can do the report on the spot and email it to the farmer," he said. "Most agronomists spend two hours a day duplicating their paperwork". *ESIApp* have also developed Spray App, which replaces the manual spray log, records and stores spray sheets, exports data in CSV format and stores chemical application details on *iPhones* and *iPads*.

The new company's first inclination was to dive straight into developing a replacement for the farmer's pocket notebook. A look at the minimal penetration of smartphones and tablets into the agricultural sector argued against this, and *ESIApp* is instead taking a staged approach. At $1,200 for a one-off lifetime payment, all future upgrades included, *Agro App* (8.3mB) is an anomaly among the 350,000-plus apps in Apple's app store, most of which are

[32] Cawood, M. (2011, March 26th). An `Ezi' app for farmers - National Rural News - Agribusiness and General - General - Queensland.

[33] Leggatt, J. (2011, June 3). *Weeklytimes now*. Retrieved June 2011, from http://www.weeklytimesnow.com.au/article/2011/06/03/338271_machine.html

priced in the $2-$10 range. Interestingly, the joint venture tired of using contracted app developers to write their application, have employed a software developer on a more or less fulltime basis to develop their applications[34]. (More information on the *ESIApp* can be obtained from www.eziapp.com.au).

A new smart phone application is helping farmers monitor water and stock movement while away from the farm. The "*Observant" iPhone* and smart phone application has the potential to save time, cut costs and reduce stress. The application is used to monitor and adjust water levels in tanks, dams and channels and water flows in pipes, tanks and pumps and relies on a web-based system which stores information gathered from the paddock via telemetry, cameras and automatic rainfall stations. A trial of the technology involving Meat and Livestock Australia near Dubbo NSW is reported to show the app was cost effective and likely to have a good uptake, especially among younger farmers[35].

Mr Mark Gardner of Vanguard Business Services is quoted as saying that the application will assist those farmers with limited access to labour and inconsistent water supply. Trials have shown the pay-back period to be about 12 months, according to Mark Gardner. "It saves time in the farmer driving around as well as fuel and wear and tear on the vehicle, let alone piece of mind." A farmer from near Geurie is claiming the technology saves him more than 10 hours time per week. When the water tank levels get to critical levels, the technology automatically sends a warning message to the farmer's mobile phone. As the system automates the starting and stopping of water pumps, the farmers can be on the farm or away from the farm and still monitor their water supply. The program is free from the *iPhone* app shop[36].

The *Weekly Times Now* reports on farmer Gareth Mizzeni who thought there must be a better way to manage his cropping business after relying on his scrawled notes[37]. Gareth Mizzeni is quoted as saying, "we used to keep all our notes in this old book and sometimes, before we got back to the house, we would forget to write stuff down. I would often carry my phone in my pocket and I would think how handy it would be if I could use an online app instead."

Gareth Mizzeni who is aged 37, from Kooroocheang, near Daylesford, worked with a software developer and, a few months later in May 2011, the app, *Farm Manager* was created. The app allows farmers to record cropping, livestock and machinery procedures on their *iPhone*. It records the full history of crops, sowing and harvest details, chemicals and fertiliser use, keeps track of livestock including shearing, drenching and crutching dates and records machinery maintenance. The *Farm Manager* app is available through the Apple store at a cost of $19.99 taking up 0.7 mB of space. Example screenshots are shown in Figure 7.

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[34] Campbell, David, 2011, pers. comm.

[35] Gadd, G. (2011, April 21). *Weeklytimes now*. Retrieved June 2011, from http://www.weeklytimesnow.com.au/article/2011/04/21/321611_business-news.html

[36] Gadd, G. (2011, April 21). *Weeklytimes now*. Retrieved June 2011, from http://www.weeklytimesnow.com.au/article/2011/04/21/321611_business-news.html

[37] Leggatt, J. (2011, June 3). *Weeklytimes now*. Retrieved June 2011, from http://www.weeklytimesnow.com.au/article/2011/06/03/338271_machine.html

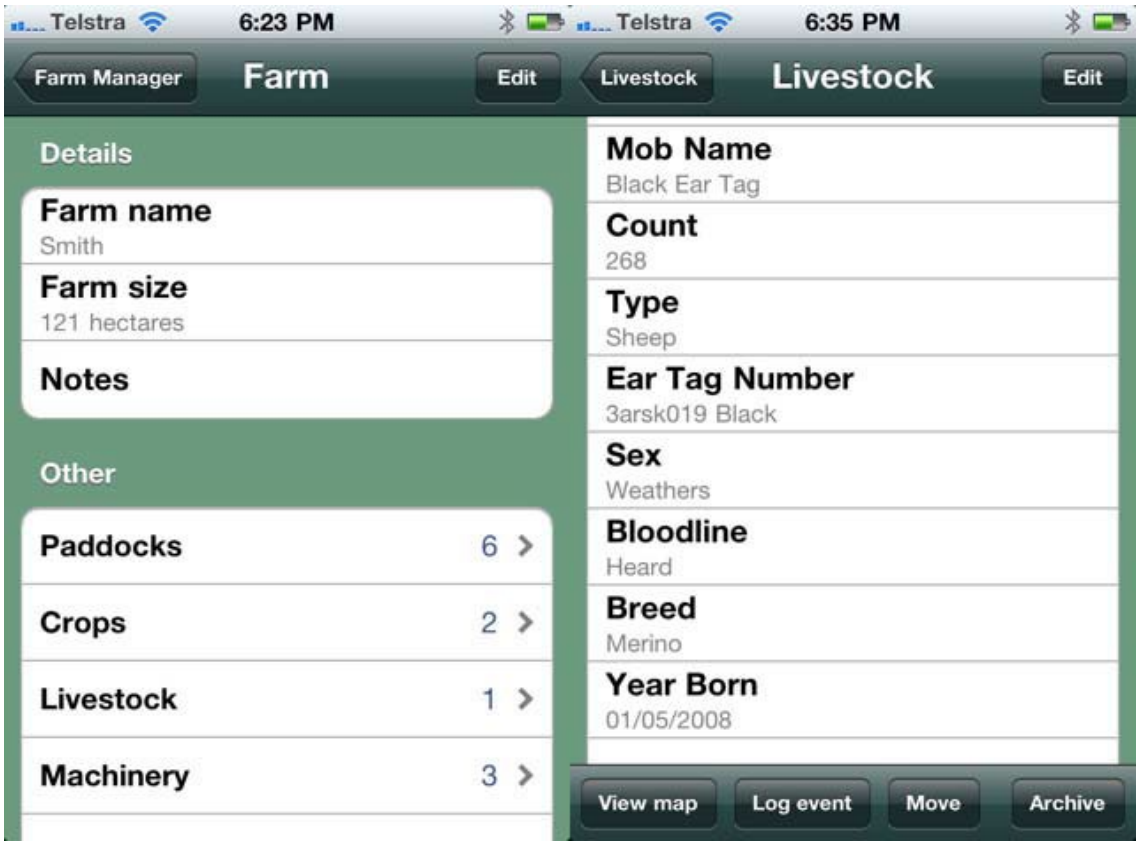

Figure 7. Screenshots from *Farm Manager* app. Source: (iTunes Preview 2011).

Early in 2011 the Extension Service of South Dakota State University developed a new app for producers and their smartphones. The app allows producers to identify noxious weeds and input grazing records from the paddock. The app (0.2 mB) is currently available for *iPhones, ipads* and *iPods touch* and once downloaded does not need to connect to a network in order to retrieve information. Figure 8 shows two of the screenshots from this app.

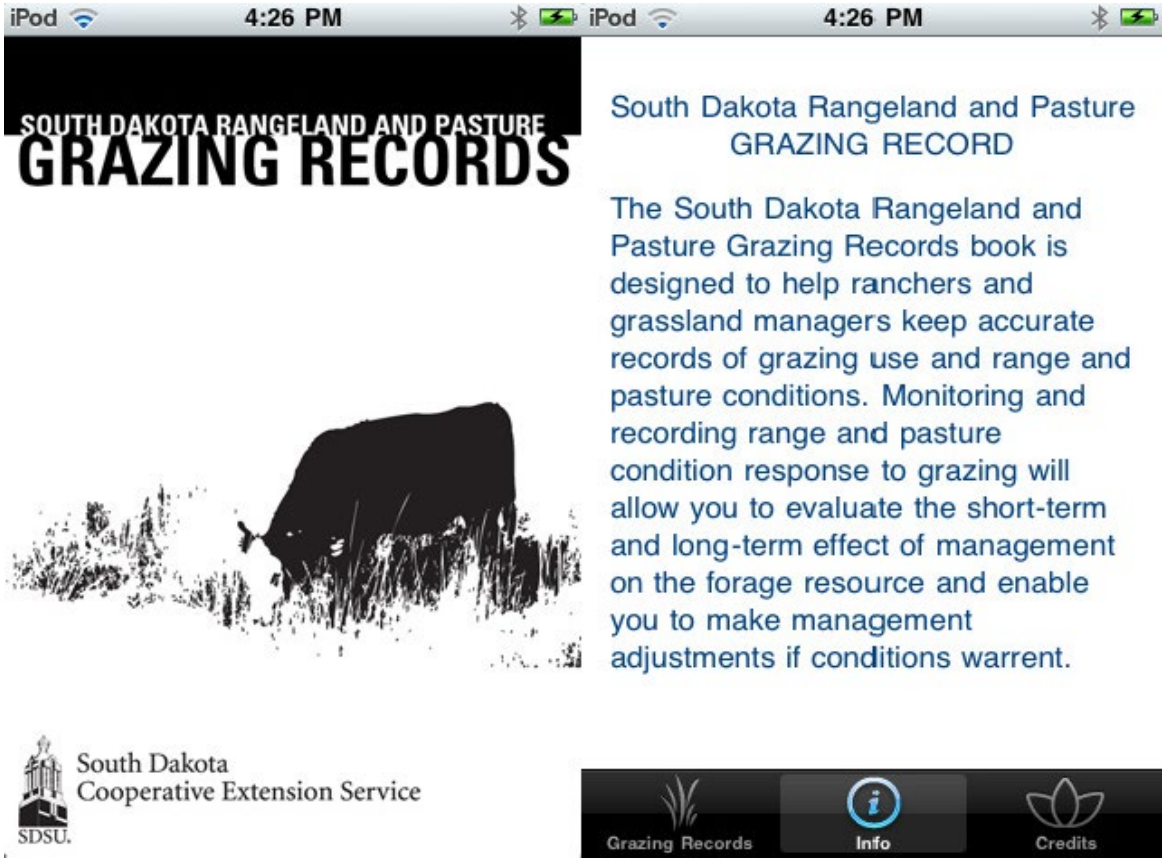

Figure 8. Screenshots from the South Dakota rangeland and pasture grazing records app. Source: (South Dakota Cooperative Extension Service 2011).

The Grasslands Society of NSW has listed a number of apps they see relevant to agriculture.

Agriculture specific:

- *Agro / Agro Lite* – paddock record system for farmers and agronomists. Full version quite expensive but you can try the Lite version for free. For *iPhone* or *iPad*
- *Spray / Spray Lite* – Spray log system for farmers. Full version a bit expensive but you can try the Lite version for free. For *iPhone* or *iPad*
- *DTN/The Progressive Farmer* – agricultural news, markets and weather. Free but USA focused. For *iPhone* or *iPad*.
- *IFarmer:Inventory* – inventory or recording for livestock management. For *iPhone* or *iPad*
  SDCES Grazing Records – records grazing use and pasture condition. Free. For *iPhone* or *iPad*
- *Cattle Breakeven Analysis* – tool for quick breakeven calculations For *iPhone* or *iPad*.
- *Farmers Partner* – Grain marketing/budgeting. Android.

Mapping:

- *Google Maps* – free and a "must-have"
- *Land Area Calculator* – calculate area of polygon on a map. *iPad* only.
- Numerous GPS and GIS apps

General Utilities

- Unit Conversion – numerous apps to convert metric and imperial units.
- Calculators – numerous apps to choose from.
- Measuring – apps for measuring height/distance from photos, rulers, spirit levels, timers, protractors, compass, etc
- To-Do Lists, Task Managers and Sticky Note apps
- Weather apps – Weatherzone or BOM Water Storage.
- News – numerous apps to choose from.

Nature:

- *Field Guide to Victorian Fauna* – a fantastic guide to wildlife (Victoria only but plenty of overlap for NSW readers). Free. For *iPhone* or *iPad*
- *WA Snakes* – describes the 54 venomous snakes of WA. For *iPhone* or *iPad*
- *BirdSight Australia* – for birdwatchers to records observations For *iPhone* or *iPad*.
- *Plant Pathology* – encyclopedia of plant diseases. For *iPhone* or *iPad*.

Education:

- *iTunes* University: free podcasts from Cornell University, Yale, UCTV, Texas A&M, CSIS, etc
- *Climate Mobile* – for long term, global climate information. Free. For iPhone or iPad.

4.1.4 Forage monitoring and land condition decision support systems

4.1.4.1 Forage budgeting

If the proposed land management app is developed it would be advantageous to have a tool that could both quantify the feed available and the quality of the feed. This could be used to predict average animal daily weight gain.

The ability to reliably estimate daily animal liveweight gains with an app across a range of pastures, land types and animals may require further research and development.

The *Pastures from Space* program developed by a partnership involving CSIRO Livestock Industries, the Department of Agriculture of Western Australia and the Western Australian Land Information Authority (Landgate) provides estimates of pasture production during the growing season by means of remote sensing. Satellites orbit the earth twice a day collecting the infrared response of pastures. The data is then used to estimate the rate of pasture growth during the growing season. Farmers using their computer can navigate and zoom-in to their paddocks by using map layers such as road and town names. Weekly data is also downloadable for use in estimating pasture growth rates of paddocks which can help calculate feed and livestock quantities to keep on the farm.

Satellite data is used to accurately and quantitatively estimate pasture or *Feed On Offer* (FOO) or combined with climate and soil data is used to produce Pasture Growth Rate (PGR) estimates. Estimation of PGR and FOO using remote sensing provides temporal and spatial information on feed resources allowing producers to more effectively manage their enterprise and potentially raise the productivity and profitability of their businesses. It is also possible that an objective measure of the spatial variation of pasture production will highlight opportunities to improve the environmental management of the landscape. Matched with electronic delivery of the information (email or web based) near real time decisions can be

made. The technology has been widely trialled by Western Australian farmers, where PGR information is broadcast on ABC Radio and signposted in regional areas[38].

The remote sensing technology used by Landgate can estimate feed on offer in kilograms per hectare per week or month with an accuracy of +/- 10%, however the technology cannot estimate the quality of pasture. A Greenness Index can be reported, however this cannot be used as a surrogate for ground cover in northern Australia, except during the wet season, when ground cover is normally not an issue. Adoption of the technology is the problem and improvements to the literacy of the technology are necessary[39].

Landgate have expressed an interest in trialling the proposed land management app if progressed and may be able to assist in naming competent app developers who have some agricultural knowledge.

Fairport Farm Software has a commercial relationship with the *Pastures from Space* program, where *Fairport* markets software to utilise this information supplied by users subscribing to *Pastures from Space*. The software named *Pasture Watch*™ allows the user to:

- View paddock by paddock pasture growth rates and pasture production.
- Compare paddocks (even compare paddocks with previous years, or the farm average).
- Know your paddock by paddock pasture status without leaving the office or even when you are away from the farm.
- Budget and plan grazing with the pasture budgeting module.
- Calculate required stocking rates using the "Green Feed Planner" module.

The quality of the diet consumed by cattle is one of the main determinants of productivity i.e. reproductive performance, growth rate and carcass quality. Technology using Faecal Near Infrared Reflectance Spectroscopy (NIRS) is able to predict diet quality in grazing cattle.

The full range of attributes for which calibration equations has been developed comprises:

- Forage crude protein
- Dietary digestibility
- Roughage metabolizable energy
- Dietary grass and non-grass proportions
- Intake of digestible dry matter
- Rate of gain in growing cattle
- Faecal N concentration[40].

The benefits of the technology include:

- Decision making tool for cost-effective supplementation,
- Decision making tool for forward planning (marketing) based on current growth rates,
- Enhanced capacity to determine nutritional requirements of grazing cattle for different performance attributes,
- Greater understanding of nutritional limitations to productivity in grazing cattle.

Research conducted across northern Australian has shown that analysis of faecal samples using Near Infrared Reflectance Spectroscopy (NIRS) technology can assist cattle producers

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[38] *Pastures from Space*. (2006, November 9). Retrieved May 2011, from http://www.pasturesfromspace.csiro.au/index.asp

[39] Abbott, S. and Stovold, R. pers. comm.

[40] Symbio Alliance. (2006). *Faecal NIRS for predicting diet quality in grazing cattle*. Retrieved May 2011, from http:www.symbioalliance.com.au/Faecal

to more accurately measure pasture and diet quality. An example of the results that can be expected using NIRS is shown in Table 4. NIRS is a valuable management tool, particularly for predicting animal responses to NPN or rumen degradable protein.

Table 4. Example of typical NIRS results. Source: (Symbio Alliance 2006)

Crude Protein %	Faecal nitrogen %	Digestibility %	Non-grass %	Weight gain*
4.9	1.3	48	3.0	-0.25 kg/day

*Estimated weight gain without use of supplementation

It may be feasible to couple NIRS results on diet quality with paddock forage budgets to estimate animal average daily weight gains over a set period of time for a set number of cattle.

To achieve meaningful estimates of both pasture quantity and quality using an app, research would be required to validate this over a range of land types, pastures, supplementation strategies and classes of cattle.

4.1.4.2 Land condition monitoring

In northern Australia *Stocktake* and grazing charts are the predominant land condition monitoring and forage budgeting training packages *Stocktake* as developed by DEEDI is based on the ABCD Grazing Land Condition principles. The ABCD land condition-scoring framework, introduced in the Grazing Land Management Workshop, provides a standard means of assessing and rating grazing land condition[41]. This framework scores land condition based on an assessment of key indicators of current soil, pasture and woodland condition. “A” land condition is when the ecosystem is in the best condition and ecosystem processes, including cycling of nutrients, cycling of water and energy flow, are most efficient. “D” land condition is when it is poorest and requires remediation.

Grazing charts as used by practitioners of the more intensive and rotational grazing systems provide a record of paddock stocking rates and rainfall that can be used to assist the planning of future grazing. Grazing charts are used as a monitoring tool to record rest periods and resting paddocks, paddock productivity, stocking rate and stocking rate relative to carrying capacity.

Stocktake is a paddock-scale land condition monitoring and management package that has been developed to provide grazing land managers with a practical, systematic way to assess land condition and long-term carrying capacity, and to calculate seasonal paddock forage budgets. Using indicators of paddock condition, together with grass growth predictions for local land types by GRASP, *Stocktake* allows managers to quantify the effect that suboptimal land condition is having on their long-term paddock carrying capacity[42]. The forage budgeting technique has been included as a second component of the system. It provides a dynamic tool for land managers to adjust stock numbers based on seasonal forage supply.

[41] Chilcott, C.R. *et al*. (2003) Grazing Land Management Workshop Notes – Burnett. Meat and Livestock Australia Limited, Sydney

[42] Littleboy, M. and McKeon, G. (1997) Subroutine GRASP: Grass production model. Appendix 2 of 'Evaluating the risks of pasture and land degradation in native pasture in Queensland'. Final Project Report for RIRDC project DAQ124A. Queensland Department of Natural Resources, Brisbane.

Prior to the development of *Stocktake*, the most commonly recognised pasture monitoring system in Queensland was *GRASS Check*[43]. Land managers using *GRASS Check* developed a high level of awareness and knowledge of the pasture species present in their paddocks, however, few were able to apply such raw data in their strategic or tactical decision making.

The *Stocktake* database has been a one-stop portal for storing and synthesising data about paddock land condition (pasture, soil and trees) and forage condition. The program uses the raw paddock data to generate resource condition ratings and calculate paddock carrying capacities. The output is presented in reports which summarise:

- paddock observations and photos
- the condition of the respective units of land in a paddock
- current seasonal carrying capacity of the paddock, and
- long-term carrying capacity of the paddock.

The problem with *Stocktake* in its current form is that producers require a range of printed materials, along with a GPS and camera to undertake their grazing land monitoring assessments. They then need to return to the office and input this information into the software before getting a result. An alternative is to use an app to digitally assess and record paddock information which allows forage budgeting to be completed in real time and all other monitoring results to be stored in the smart phone and later automatically downloaded to a computer.

The *Stocktake* database is available to clients (both landholders and agency people) as part of the *Stocktake* training package. The *Stocktake* database has approximately 1,000 existing clients across northern Australia and this is anticipated to increase in coming years. In the 2009-10 year alone, *FutureBeef* staff conducted 11 *Stocktake* workshops attended by 104 businesses; covering 2,239,984 (~2.2 million) hectares of country carrying 257,996 head of cattle and 24,171 head of sheep.

5 Consultation with software specialists

Several software/app development organisations were contacted and the proposed land management app was discussed. These organisations included:

1. Kintek, Brisbane
2. Geomatic Technologies, Brisbane
3. Liquid Interactive, Brisbane
4. Crunch Computers Pty Ltd, Mooloolaba also trading as iApps. (Full quote in Appendix 4.)
5. Dataone, Brisbane
6. Creatop, Brisbane
7. Landgate, Perth
8. Fairport Software, Perth
9. Freshweb, Sydney.

The general advice from the app developers was to target the most common operating system that will be used by producers into the near future.

Building an app that is not reliant on web connectivity (cache enabled) is simpler and less costly than constructing an app which is dependent on the web.

Synchronisation of data between the app and a standard office computer is not simple; however it is relatively easy to build an app such that data can be exported to another

[43] Forge, K. (1996) GRASS Check – Grazier Rangeland Assessment for Self-Sustainability. Information Series Q194005. Queensland Department of Primary Industries, Brisbane

computer program. For example, this may be through the use of data saved in a pdf or csv format. (The comma-separated values (CSV) file format is a set of file formats used to store tabular data in which numbers and text are stored in plain textual form that can be read in a text editor and moved between different computer programs, e.g. from a database program to a spreadsheet program.) Another option is to allow integration between the mobile device and a computer by using email to transfer, save, and store data and image files.

Synchronisation between a smartphone app and the grazier's office computer is important if the user wants to backup data and images and also print reports and images.

A web site and associated e-learning tools, plus some paddock training workshops, may need to be developed to encourage adoption of the app, provide technical support, refine users' field skills, and build greater confidence in the results generated by the app.

It was generally agreed that the device running the app should have a high resolution screen and a zoom function if the user is to use photographic standards effectively. These pasture photo standards are already available however, the existing *Stocktake* program and a potential app would benefit by having an expanded database of relevant, high resolution pasture images. The app should incorporate a design such that using it is largely intuitive.

Estimates of cost to build the app varied from $50,000 and $150,000. A full cost estimate totalling $120,000 plus GST was provided by iApps and is contained in Appendix 4. This involved providing detailed specifications to iApps. In comparison, a cost estimate was provided by Freshweb following a single meeting and this estimate was $40,000 to $45,000 plus GST.

Sufficient memory for storage of photographs, reference images/data and recorded data is critical. Limited handset memory may restrict the number of screenshots available within the app.

It was suggested by some app developers that the screen size on most smartphones could be an impediment for uptake, particularly by older producers who may need to wear reading glasses to see the screen images, particularly when estimating dry matter yields from photo standards. The alternative is to use the app in a tablet or laptop, however this lessens the portability advantage of using a smartphone which can be used for phone calls where a signal is available. It was pointed out that current smartphones will not allow the user to compare photos on the same screen shot, however this is possible on tablets.

One of the suggested requirements in building the app is to ensure the architecture is layered or extendable to allow for later upgrades of the app. Working with this sort of technology requires planning for technological change into the future.

It is envisaged that the existing *Stocktake* program will require a minor rewrite prior to its adaption to an app. Further development of the photo standards would also be beneficial for the app's success (this is being discussed by DEEDI and DERM).

In selecting an app developer, consideration must be given to on-going technical and development support.

There are two stages in design and costing of the app, i.e. a preliminary design and scoping analysis stage followed by a complete design/costing stage. The preliminary design and scoping analysis stage generally involves a one-day meeting with the app developer where the basic design parameters and business logic are expounded. This stage was completed as part of this project with *iApps*. This will allow an estimate of design complexity, cost and time to be provided by the app developer. If this preliminary estimate is acceptable, a

detailed design specification that matches all requirements can be prepared which includes full and accurate costing with associated developmental milestones. At both stages, it would be advantageous to have a small steering group of potential users of the app involved in the deliberations.

After the app is developed and tested in house, this would be followed by a piloting phase and further refinements to the app as needed. There may be scope for a partnership arrangement with an app developer if the app was thought to be commercially viable.

During the development of this project, there was discussed about having both producer and advanced versions of the app that could be developed in parallel. The advanced version would offer additional features such as links to mapping programs, *VegMachine* and *1234 Biocondition* indicators. This advanced app would be targeted towards NRM field staff, advisors and consultants. When talking with software specialists this idea was discussed, however the project team decided it was best to focus on the producer level app as a starting point but ensure the software programmers built this app with an advanced version in mind for future additions. This is technically feasible particular if the app is well designed from the beginning. This project has focused on developing a least cost app to do the priority features, of direct value to producers, very well in the first instance and then consider building an advanced version later down the track if the producer version was a success.

An important consideration is that the software behind the app should be open and readable by other software specialists such that changes can be made without fuss and too much additional expense.

As part of this project, a preliminary design and scoping analysis (half-day) was undertaken with Crunch Computers (iApps) located at Mooloolaba. This company is already developing a commercial app to assist with herd management. The cost to undertake this design and scoping phase was $2,600 (inclusive of GST). Attending this meeting with Crunch Computers was Jane Hamilton, Steve Banney and Jill Alexander (DEEDI). A full copy of the resulting report is contained in Appendix 4. The estimated cost to build the app to the prescribed specifications is $120,000 plus GST.

Crunch Computers was approached by Will Wilson of Calliope Cattle Company in central Queensland to develop an app to help the Wilson family and other graziers manage their herd and associated records. The app will have full internet connectivity and will run on the Apple operating system. It is envisaged the *iphone* and the app called *iHerd* will replace the traditional paper notebook found in many grazier's shirt pocket (Wilson, W. 2011, pers. comm.). The *iHerd* app will be able to run on both *iphones* and the cheaper *ipod touch* devices. The first version of *iHerd* was released in August 2011. The development of this app took some 9 months and will cost in the order of $150,000. The cost to download the app from the Apple store will be approximately $300 and take up approximately 20 Mb of memory. The developers of *iHerd* see the app as a tool to assist in the overall management of the grazier's herd and in particular linkages to the National Livestock Identification System (NLIS). Will Wilson sees scope for the proposed land management app to compliment the *iHerd* app.

5.1 Consultation with producers and grazing land advisors

As discussed as part of the methodology, the views of producers and grazing advisors were largely documented through the use of an online and paper survey – see Appendix 3.

A survey was designed to capture the perceptions of producers and advisors with regards to the proposed app. Usefulness of the app and benefits to industry were key questions. Other key questions related to industry practice on forage budgeting and land condition

assessments. Producers or advisors keen to pilot the app (if developed) were able to express this interest through the survey.

1.1.2 Current industry practices for land condition assessment and forage budgeting.

The survey registered 125 responses from producers and advisors spread across all regions in northern Australia. This sample of producers and advisors was not a random sample of respondents rather it was dependent on interest from MLA members and partner organisations. It is likely the only commonality amongst the respondents was an interest in land management. The main income producing split of respondents can be seen in Figure 9, where 59% of respondents were beef only producers and 25% fall into the broad category of advisors.

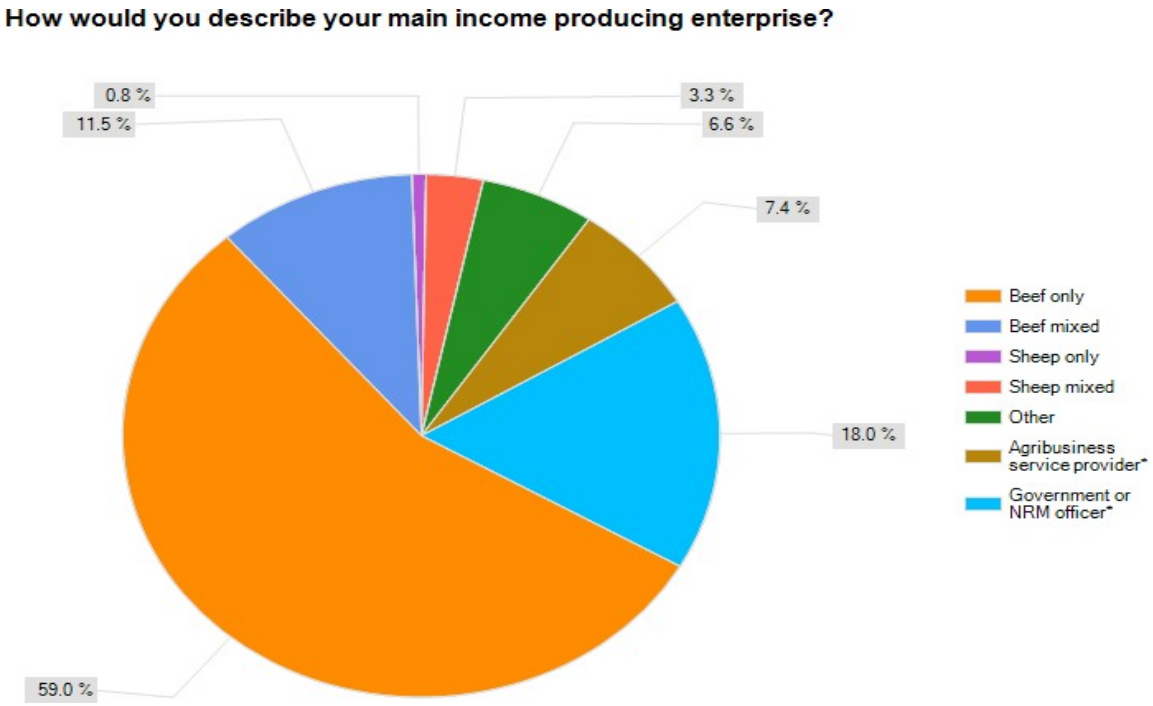

Figure 9. Survey respondents' main income producing enterprises.

Advisors were asked to complete the survey based on the average for their clients.

Around 58% of respondents currently estimate and record land condition (ABCD or similar) and ground cover percentages for some or all of their paddocks. The methods use by these respondents to estimate and record land condition varied with 77% using 'other' method and 23% using *Stocktake*. 'Other" methods specified ranged across a spectrum from "gut-feel", visual observation, experience, photos at monitoring sites, photo standards, EDGEnetwork *GLM/$avannah Plan* approach, rotational grazing charts, *Grasscheck* and *Landscape Function Analysis.* It appears that about half the respondents using these other methods employ less objective methods such as gut feel, visual observation and experience.

Approximately 76% of respondents currently do not complete a forage budget for some or all of their paddocks. Of the remaining 24% who do forage budgets, 49% use a grazing chart, 17% use *Stocktake* and 34% use other methods. Other methods include visual observation, experience, GLM type method, Excel spreadsheet and 'experience'. Formal forage budgeting appears to be most commonly practised by producers using grazing charts as part of an intensive grazing system. The frequency of those undertaking forage budgeting ranges from once per year to 160 times per year, with a median frequency of twice per year. Those producers undertaking the higher frequency of forage budgeting are presumably those using

more intensive grazing strategies where numerous paddocks are used in a time controlled grazing system using relatively large numbers of stock in one mob.

Some 22% of respondents currently own a smart phone or tablet, 78% do not. Table 5 documents the percentage of various platform users or future users amongst industry. Apple is the preferred platform however many respondents commented that they own or purchase phones based on service and coverage.

Table 5. Percentage of various platform users or future users amongst industry

Platform/device	Current smart phone or tablet platform (% of respondents)	Device platform likely to own and use in next two years (% of respondents)
Android	20	8
Apple	64	54
Blackberry	8	0
Tablet	8	0
Unsure	0	38

1.1.3 Usefulness of the app and benefits to industry

Overall 76% of survey respondents thought the 'app' would be either useful or very useful to the grazing industry in northern Australia.

For those respondents currently not doing land condition monitoring 78% said that the app would help them get started. While for those currently monitoring, 73% said that the app would increase the number of paddocks or frequency of which they did an assessment because all the tools and information would be in one spot and results are only recorded once. These results are encouraging however they should be tempered by what might be called the "keeping up with the Jetsons'" phenomenon. It is reasonable to assume that most respondents want to be viewed as doing the right thing for their land, however probably more relevant in this instance; most producers do not want to be perceived to be left behind with new technology even though they may have had little personal exposure to smart phone technology or apps.

For respondents currently not using forage budgets, 82% said that the app would help them get started. For those currently doing forage budgets, 74% said that the app would increase either the number of paddocks or frequency of forage budgets. Similarly these results are encouraging, however they should also be moderated in view of the comments above under land condition monitoring. It is reasonable to say that the majority of producers do not keep good records related to their land, livestock and financial management. It is feasible that as smart phone technology and app use generally increases across all aspects of daily life that this will increase the likelihood of producers using an app to record both land condition and undertake forage budgets. Of the 74% of respondents who said that the app would increase their use of forage budgeting, this is rather unexpected as most of these respondents are currently using manual grazing charts and not *Stocktake*. This result is interpreted as a high proportion of respondents incorrectly assuming the app would incorporate a grazing chart approach.

Survey respondents were asked about their perceived benefits of using the proposed app. Figure 10 shows the range of responses from survey responses to the statement; *I believe a suitable land monitoring and forage budgeting app developed with industry consultation will….* The proposed app is likely to allow producers to make better informed and more accurate stocking rate and land management decisions. Saving time on monitoring for management and compliance was the other major perceived benefit. Only 8% of respondents said the app will be of no value to them. Although these are perceived benefits

based on limited exposure to apps, respondents were able to see the benefits of using the proposed app.

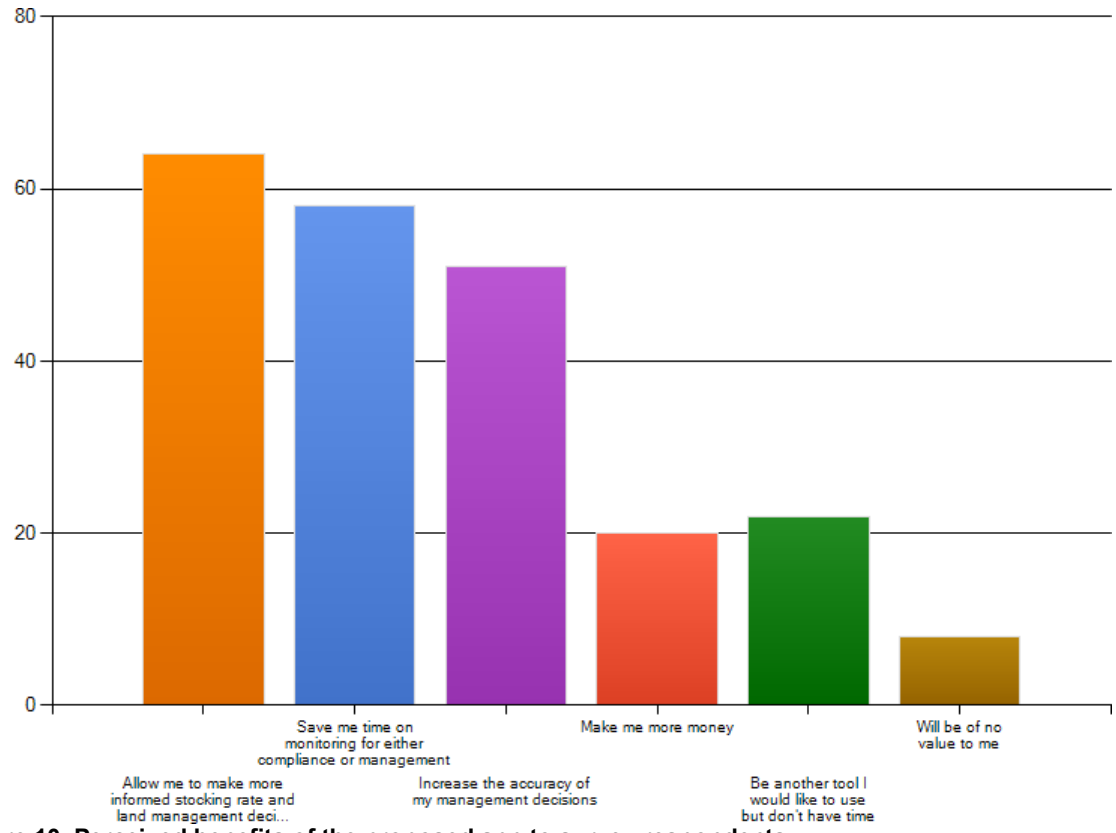

Figure 10. Perceived benefits of the proposed app to survey respondents.

Survey respondents were also asked which features were most important to them in the proposed app. Respondents were asked to rate a number of choices from 1-8 in priority order and list any other features they thought should be incorporated into the app. Figure 11 shows that the priority features were: should allow the app to undertake a forage budget (1st), assess/record land condition (2nd), estimate/record ground cover (3rd) and estimate cattle liveweight gain (4th). The fact that the highest or first priority for the app is to undertake a forage budget is remarkable given the existing, relatively low adoption of forage budgeting by respondents. However it appears the possibility of using an app struck a chord with many respondents who currently find forage budgeting difficult, clumsy or of no tangible value to their business.

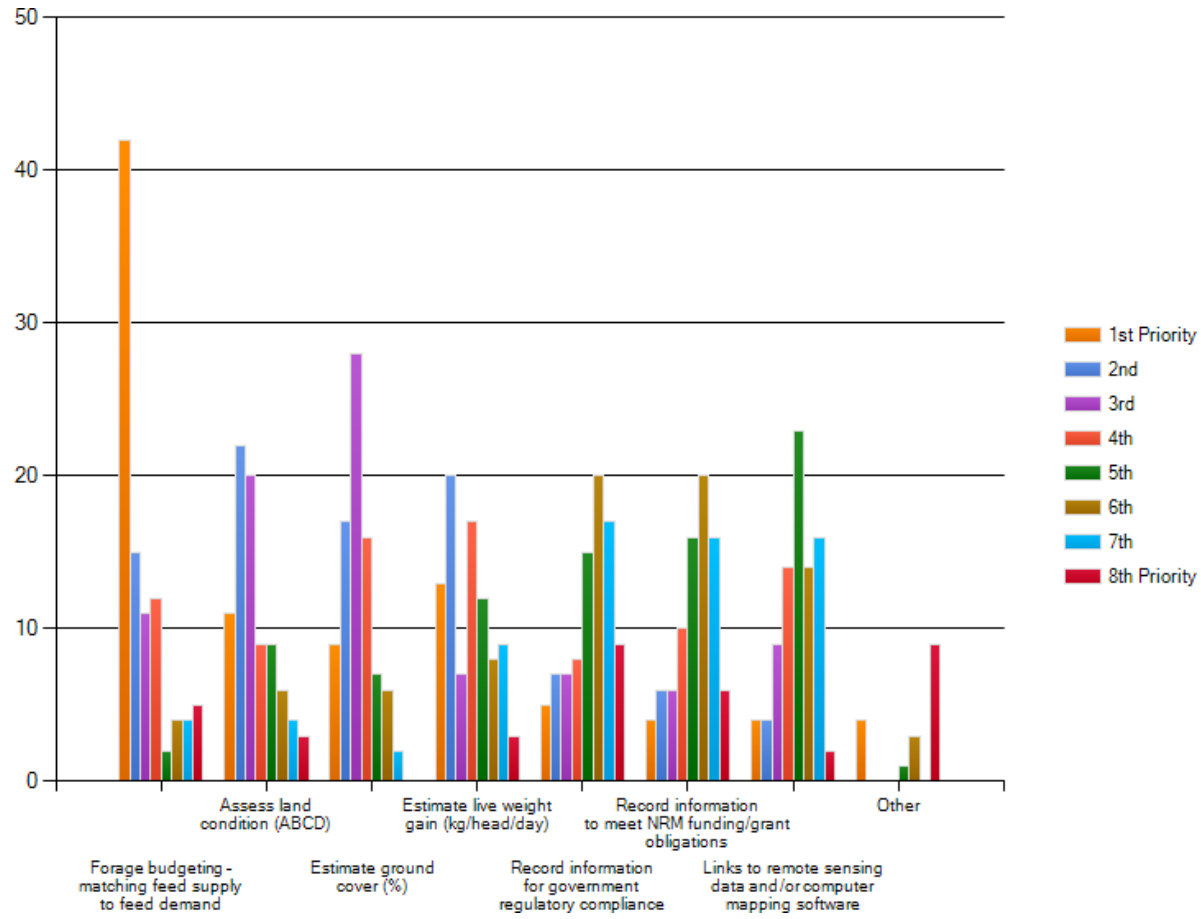

Figure 11. Features prioritised for the proposed app.

Suggested 'other' features for the app included;

- Time lapse history of photos
- GPS capabilities
- Long-term carrying capacity estimates
- Rainfall data
- Weeds locator (GPS enabled)
- Plant and weed ID
- Link to phoenix maps and other programs
- Notepad or voice recorder to jot down other issues whilst in the paddock e.g. broken wire, water problem, mining company breach etc

A number of these features have been included in the scope developed with *iApps*.

Importantly, survey respondents were also asked how much they would be willing to spend on the proposed app, see Figure 12. The most common response (30%) said less than $50 however there was a significant proportion willing to pay up to $200 and some willing to pay over $400. By comparison *Stocktake* software and the one day training workshop currently costs $330/business.

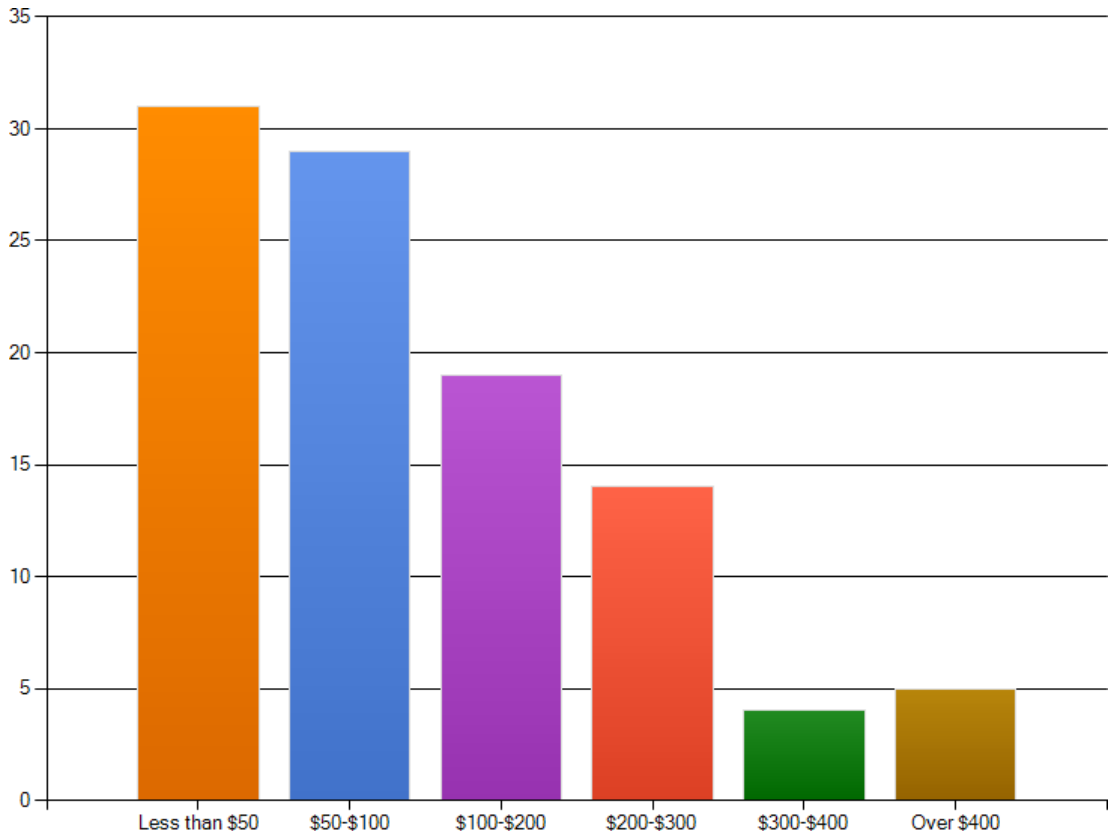

Figure 12. Dollar value survey respondents would be willing to spend on the proposed app.

As a measure of predicted uptake and as a means of determining the level of interest from producers and industry stakeholders in piloting the proposed app as it is developed the survey asked respondents about follow-up post survey. Some **65% of respondents said they would be keen to test the app and provide comment as it is developed. Around 57% wanted to be notified when the app was ready** and only 7% did not want to be contacted further about this project.

It is acknowledged that the survey was not conducted with a random selection of northern producers and for this reason will include a degree of bias. It is also appreciated that people willing to fill out the survey on the proposed app were likely to be more interested in the concept to start with given the attraction of new technology and of a novel, additional use for their mobile phone. However, paper based surveys were available at a number of workshops and meetings and through this process we did get a broad spectrum of responses (positive and negative) to the proposed app concept. In particular the discussion on the value of forage budgeting to industry was often raised, with some producers in some areas noting that forage budgets were not “relevant” to them. On the other hand we did have feedback from a number of respondents suggesting that although they personally may not use the app they see technologies such as the proposed app as important tools to encourage and maintain younger staff and family members on farm.

5.2 Consultation with industry stakeholders

Discussions took place with the following industry stakeholders and is summarised below.

- Agforce projects
- Department of Environment and Resource Management (DERM)
- Resource Consulting Services (RCS)
- Western Australia Department of Agriculture and Food, and
- Cooperative Research Centre for Remote Economic Participation (CRC-REP)

Discussions were held with individual representatives from each organisation. Many of the opinions and thoughts expressed by those we met were both a combination of "company" and personal opinions.

Discussions with AgForce Projects about the feasibility of the proposed land management app focused on the importance of use-ability, functionality and flexibility.[44] Overall Agforce projects supported the idea of the proposed app and thought it would be useful to industry particularly those affected by Delbessie, Reef Protection legislation or both. The producer must be able to see value in using such an app, which is firstly a function of the tangible benefits of forage budgeting and secondly what method is used to forage budget.. To be functional, the app must be visual and graphic. Comparisons were made between producers adoption of mapping software and GPS devices with a land management app.

The anecdotal evidence is that many producers quickly lose interest in software and GPS units unless it significantly adds value to their business or helps them comply with legislation.

It was agreed that a suitable land management app would assist regional NRM and Reef Rescue extension officers in their respective roles. Asking producers what they think they will want to use in the future for mobile telephone communication is essential.

In terms of incentives for producers to take on new technology, the two proven incentives are meeting legislative requirements and obtaining funding following a natural disaster like drought, fire or flooding. Another incentive comes into play if landholders receive funding from NRM bodies to improve or protect land resources. Normally a condition of such funding is for the landholder to monitor changes in land condition over time.

Discussions with the Queensland Department of Environment and Resource Management (DERM) have revealed that a land management app could be a valuable tool for landholders and may constitute 'supporting evidence' on landholder practices. However DERM has in place its own regulatory requirements for monitoring as part of the *Delbessie* Land Management Agreements and requirements under the Reef Rescue's Environmental Risk Management Plan (ERMP). DERM cannot support any approach they may undermine their own policies and guidelines[45]. For example, DERM does not support the ABCD classification of land condition promoted by *Stocktake* and other related grazing management training. In other words a landholder monitoring their land condition and reporting using *Stocktake* or an app based on *Stocktake* is not '*defensible evidence'* in the view of DERM. To meet DERM's duty of care under the *Delbessie* Agreement, land condition is assessed under eight land attributes comprised of 23 indicators and this must be assessed on each lease by a DERM officer. Under the requirements of the Delbessie Land Management Agreement, DERM sees the app as a form of landholder self-assessment for the benefit of the producer alone. This is not likely to be the case under the existing Reef Rescue regulations, where this form of landholder self-assessment may compliment the regulatory landholder records.

It appears likely that DERM will be developing their own electronic systems for monitoring under the *Delbessie* and *Reef Rescue* frameworks at some future point in time. The difference between what the proposed land management app will do and what DERM is planning is the capacity for landholders to do forage budgets. Forage budgeting is a major component of the existing *Stocktake* program and the proposed land management app.

Having explained the objectives of the proposed app to DERM, they see it as a way to potentially improve land management; however the biggest risk of failure as they see it will

[44] Brinsmead, N. 2011, pers. comm.

[45] R. Hassett (2011, pers. comm

be a low level of adoption. If that is the case, it may be less risky to identify a region of north Australia where likely uptake of the app is going to be higher than in other regions and develop and pilot the app with landholders in this region.

David McLean was contacted to provide some comments on the proposed app from the Resource Consulting Services (RCS) perspective. Overall David supported the idea. He commented that integration of Stock days/100mm/ha would be useful to RCS clients. Phoenix in conjunction with RCS was developing an electronic grazing chart; however David was not certain of the specifications in this program or its progress. The issue RCS identified was that their clients (and most of the grazing industry) struggle to use these types of decision support tools effectively as they often have poor stock records as a starting point. David thought forage budgeting was relatively simply, however, stock numbers and record keeping generally was the problem. These comments reinforce our earlier observation that most producers are poor record keepers across most aspects of their business.

Discussions with Joe Rolfe from DEEDI (Far North region) could be summarised by “good idea, industry needs it”. The Northern Gulf NRM group and DEEDI undertake monitoring over a large number of sites and this type of tool would be highly useful. Mike Digby from Northern Gulf NRM group said the proposed app was a great concept especially if linked spatially. He suggested that there was a substantial market for the proposed app particularly with young producers and NRM staff.

Discussions were held with the Western Australia Department of Agriculture and Food. Jane Hamilton met with David Warburton and Paul Novelly on the 14 March 2011. Discussions started on functionality and coverage of smart phones. As these technologies and platforms are relatively new and rapidly evolving these questions will need to be continually addressed amongst the target market and stakeholders. The WA Agriculture and Food rangeland condition trend information and framework for assessment were than discussed. In the WA rangelands there are 450 leases which, from 2011-2012, will require monitoring for land condition by the producers (either by station manager/staff or consultants). It appears a purpose built app would be beneficial in this State given their existing monitoring compliance framework. In addition, the WA frameworks and indicators are different from the ABCD framework used in QLD and would require different ‘input’ fields in the proposed app. Any State or regional differences as in the case of WA would need to be addressed in the app specifications if adoption and effectiveness is to be optimised. There would be no technical constraints in doing this, however there are likely to be additional development costs.

The Northern Territory Pastoral Land Board was made aware of the proposed app however there has been no response to date.

Discussions were initiated with Sally Leigo, Research Leader for the Precision Pastoral Management Tools Project with the new Cooperative Research Centre for Remote Economic Participation (CRC-REP). There was significant interest in the synergies between the proposed app and its scoping study and the Precision Pastoral Management Tools project. The CRC-REP project team have expressed interest in potentially being involved in the commercialisation of the proposed app. The survey findings, as part of this project, will also help direct their project proposal as the CRC-REP is taking shape.

6 Success in achieving objectives

6.1 Feasibility of developing such a tool from both a technical perspective and in terms of cost-effectiveness

Both the literature review and consultation with the software industry has allowed the technical feasibility of the tool to be satisfactorily assessed. The feasibility in terms of cost-

effectiveness is dependent on a number of assumptions on functionality of the app and likely uptake.

6.2 The likely use of such a tool by producers, including those who are currently conducting 'formal' forage budgets and those who are not.

The completion of the survey by some 125 respondents has provided an indication of the level of interest in likely use of the tool by producers. Some 76% of respondents currently do not complete a forage budget for some or all of their paddocks. For respondents currently not using forage budgets, 82% said that the app would help them get started. For those currently doing forage budgets, 74% said that the app would increase either the number of paddocks or frequency of forage budgets. This was supported by numerous personal communications from people interested in the concept.

6.3 The likely impact of such a tool on industry's adoption of more proactive and effective grazing management.

Overall 76% of survey respondents thought the 'app' would be either useful or very useful to the grazing industry in northern Australia. The proposed app is likely to allow producers to make better informed and more accurate stocking rate and land management decisions. Saving time on monitoring for management and compliance was the other major perceived benefit. Only 8% of respondents said the app will be of no value to them. Further information on how the project team achieved this objective may be found in the following SWOT analysis (Table 6).

6.4 The potential industry benefit of such a tool

Speculation has been provided on the potential benefits to industry of the proposed app in conjunction with likely impacts on grazing management practice change.

7 Impact on meat and livestock industry – Now and in five years time

7.1 Now

Given there are no technical obstructions to providing industry with the proposed app, the impacts on industry in the immediate future will depend on how extensively the app is taken up by industry. This will depend on a range of factors including:

- Usability of the app design and layout
- Usefulness of the app (as seen by industry)
- Effectiveness of app promotion
- Cost of the app and
- Adoption of the device (smart phones) and proposed platform (Apple) for the app.

The impacts will be measurable by changes in producer practices and on-ground outcomes. It is expected, and survey results from this project predict, that a greater number of producers will assess their land condition and undertake forage budgets leading to more sustainable production and more sustainable grazing profitability.

An unexpected benefit of this preliminary investigation is the value of this project's findings to other DEEDI, DERM and independent agricultural advisors. The project team has been surprised at the high level of interest in apps, their perceived benefits and likely uptake by northern Australian producers and advisors. This is a rapidly evolving area and many extension officers see apps as a complimentary tool to increase adoption of practices or as a mechanism for raising awareness. The project's findings contained in this report will

enlighten industry to what is possible with apps, likely costs and a clear process for investigating technical feasibility and perceived uptake and benefits.

7.2 In five years time

The development and use of apps by the general community has grown exponentially in recent years and will continue to rapidly expand as smart phone technology evolves and more and more apps are brought onto the market. In line with this trend, greater numbers of producers will be looking to use apps which will improve their business knowledge in a cost effective way. Provided the proposed app continues to be seen by producers as a practical tool in grazing land management, practice changes as described earlier will continue to be adopted.

8 Conclusions and recommendations

8.1 Conclusions

There are no significant technical obstructions to developing a land management app which is based on the *Stocktake* program. At an estimated development (only) cost of around $120,000 plus GST, this project is not without risk due to the fact that this is a preliminary investigation and we do not have a perfect understanding of how enthusiastic northern producers would be to use the app.

There has been widespread interest in the feasibility of developing an app to assist in land management. This includes interest from producers, extension staff and NRM bodies. There is also interest in the app from MLA's southern program where the existing *Feed Demand Calculator* tool may be extended to an app. Those producers and stakeholders who took the time to complete the survey on the app were mostly in favour of seeing the app being developed (76% of respondents).

The following Table 6 shows a SWOT analysis of the development of a forage budget and land condition application.

Table 6. SWOT analysis of developing a forage budget and land condition app

Strengths	Weaknesses
• Able to make land management decisions in the paddock in one operation. • The use of the app would reduce the amount of time producers need to spend in the office to complete the land monitoring task. • App also reduces the number of resources (GPS, camera, land type booklet, photo standards etc) that producers have to get together to do their monitoring as nearly all the tools will be embedded in the device and app. • Extend the use of the *Stocktake* program. • No or minimal training in the use of the app will be required. • The general community would welcome a move by the grazing industry to utilise technology to help look after the environment. • The app has the potential to make forage	• The relatively small screen size of smart phones may deter older producers in particular to use the app. • Initially the app will be developed for one type of operating system, which may limit uptake by a proportion of producers. • Not all producers will want or need to own a smart phone so limiting the availability of the app. • The total producer market for the app in northern Australia is relatively small which may mean the purchase price of the app will be higher than most producers are prepared to pay. • There will be ongoing costs to maintain and upgrade the app and unless the app is well adopted by producers, these costs may outweigh the benefits. • State differences in monitoring frameworks (particularly compliance frameworks) could mean that the app

Strengths	Weaknesses
budgeting and land condition assessment more objective than it currently is. • Monitoring records including photographs can be securely and confidentially stored on a designated web database. • The app has the potential to help producers facilitate their own environmental self-assessment. • Reports for interested stakeholders (NRM groups, bank-managers, DERM etc) may be generated and emailed from device or PC quickly and easily. • Web-based application to support the app would broaden target market beyond those that currently own a device and platform and reduce the need for ongoing maintenance of the existing *Stocktake* software. • App web-page could allow increased communication between producers and DEEDI and MLA. 'Push' notifications and blogs could be incorporated to remind users to do their monitoring (e.g. calendar reminders) or prompt thinking (and hopefully action) about seasonal condition and pastures.	would have to be customised for various locations. This is technically feasible but would require additional coordination.

Opportunities	Threats
• The app will utilise existing smart phone technology for multiple functions. • The opportunity exists to deliver a land management app that would complement the release of the *iherd* app. • If the basic version of the app is widely adopted, there is scope to value add to the app by increasing its functionality. • The concept of the app is likely to create interest for use by producers in southern Australia. • The app is of interest to NRM groups and their staff for working with producers. • It may be possible for industry to have a commercial partner in the development of the app. • The Landcare movement and NRM groups may help promote the app to all landholders including peri-urban producers. • The app is likely to have a lot of appeal to the younger generation of producers and those currently studying agriculture. • Government regulators in Queensland, the Northern Territory and Western	• Producers in general do not attach importance to land monitoring or forage budgeting and the availability of an app may not change this viewpoint. • The capital cost of the app and the risk of poor adoption by producers may deter investment in the app. • Producers that must monitor and report on land condition as part of legislation may not wish to duplicate monitoring using an app based on *Stocktake*. • If adequate technical support and upgrades are not provided after the app is developed, the app will become redundant. • The basic app may not be simple, intuitive or visual enough for the majority of producers. • Smart phone technology may advance at such a rate that the developed app may require constant and expensive upgrading (this threat would be minimised if we choose a 'closed' platform such as Apple). • Poor promotion of the app by MLA, DEEDI, producer champions and other

Opportunities	Threats
Australia may see value in producers self-assessing their land management and may promote the use of the app. • There is likely to be strong interest from pastoral companies in the app as they have greater obligations towards maintaining the productivity of their land assets. • The app may have potential use in overseas rangelands.	stakeholders may limit the adoption of the app. • Government regulators may insist that northern producers document their use of the app to meet legislative requirements thereby creating additional red tape for producers.

The major risk in developing the proposed land management app is a lack of uptake by producers. The potential market for the app across northern Australia over the next three years is estimated at 550 producers and extension, NRM staff and advisors. This estimate comes from the knowledge that there are 9000[46] producers in northern Australia of which it is estimated 5% would download and use the app, plus 100 NRM staff and advisors. If the app was consistent with the average app price (currently $2.17) this number could be much larger and the potential audience would be worldwide rather than just northern Australia.

As further indicative measures of likely uptake of the proposed app; in August 2010 there was over 1,200 existing *Stocktake* clients. Interest in *Stocktake* continues, with an average of four enquiries to DEEDI staff about *Stocktake* software and training per month. In the last 12 months DEEDI has delivered nine *Stocktake* workshops across Northern Australia with 82 new client businesses. Of the existing clients in August 2010, when the new version of *Stocktake* software was released (version 2.7), records indicate that only 11% of these clients have updated their software from *Stocktake* 1.0. Continual upgrading of the existing *Stocktake* software to match new operating systems has been considered a barrier to ongoing use of the Stocktake software by existing clients. The app and web-based program would be the preferred future for *Stocktake*, and it would be recommend that clients would merge across if the app and associated webpage (for those not yet using smart phones) were available.

It is likely that of the estimated number of 550 people willing to download the app, provided the app was readily accessible and not too costly (under $50), it is fair to assume that only a percentage would regularly use the app. It is difficult to be precise with these numbers as the rate of smart phone adoption and app use is growing rapidly (8 times faster than the adoption of desk-top web usage). Numbers of users and frequency of use could be boosted by the general FutureBeef GLM extension effort and use of 'push notifications' and reminders through the app. It is possible to establish data feedback information into the proposed app to provide information on number of downloads (automatically provided by app server e.g *iTunes*) and frequency of use.

As an interesting note; given the media associated with our proposed app, the Fitzroy Basin Association NRM group has converted all their field staff to *iphones*. Furthermore, Stocktake workshop participants are already suggesting a Stocktake app or similar (without prompting) at workshops, to streamline the Stocktake process.

[46] Based on ABS 2006 data.

8.2 Recommendations

8.2.1 Overall

The aim of this project was to undertake a preliminary investigation into the benefits and costs of developing a forage budgeting and land condition app for the grazing industry of northern Australia. The project team has attempted to present a balanced report on the pros and cons of the proposed app and the various options (platforms) for the app if it were developed.

Our recommendations acknowledge there are some significant risks associated in investing in the development and roll-out of the proposed app. If it is assumed that an increased level of forage budgeting and land condition monitoring will lead to more sustainable grazing profitability, the risks revolve around substantial development costs and imperfect knowledge on the adoption rate of the proposed app. The grazing industry has traditionally been conservative when it comes to the adoption of new technology particularly if there are no transparent and tangible financial or regulatory drivers. The capital cost to develop the app is not insignificant and will require ongoing maintenance costs. However overall the project team believes there is value in pursuing a phase II project, which would see the app developed and piloted in industry as part of the broader grazing land management extension program. The indicative development costs contained in this report should be kept in perspective with the development costs of other new technologies such as remote animal management systems, animal and asset radio tracking tags, and electronic pregnancy testing and foetal aging systems.

There has been a historical lack of interest by northern producers to formally monitor their land condition and conduct forage budgets, however through awareness programs and compliance requirements, this is changing. The app alone will not solve the problem of poor uptake of these practices but it will make it easier for producers to complete the task as well as making the results more objective and repeatable. As earlier noted, most producers are poor record keepers on most aspects of their business. Apps that allow producers to easily and independently record and store information on the productivity of their land and livestock may act as a catalyst to improve general record keeping and in particular that related to forage budgeting, land condition and ground cover.

This project has attracted significant interest from NRM groups and the CRC-REP. As a means of reducing some commercial risk brought about by a possible lack of producer adoption or slow adoption to the use of the app, it may be appropriate to call for a business partner or partners to develop the app. With the relatively small potential market in northern Australia, it is not likely an app developer alone would be interested in partnering industry in the commercial development of the app. However a note of caution is warranted if multiple stakeholders are involved, the specifications for the app may be changed to meet individual stakeholder's agendas.

Given the recent release of the *iHerd* app in northern Australia, MLA and DEEDI could either wait and see how the app is adopted by industry or bring forward the phase II of this project to build on the momentum of the *iHerd* app's release. It may be advantageous to wait and see how *iHerd* goes in the commercial market as the majority of northern producers have a closer working affinity with their livestock than their land and pastures and may more readily adopt this app. Valuable lessons may be learnt in terms of market acceptance if the adoption and practice changes brought about by the *iHerd* app are formally monitored and evaluated before a land monitoring app is developed. Alternatively, given the pace of app development and adoption in all industries, including the beef industry, now might be the most opportune time to develop and roll-out the land management app. The impetus from this preliminary project and the recent release of *iHerd* could be managed to promote the land management

app as an up-to-date, tech savvy tool within the broader *FutureBeef* grazing land management extension program.

8.2.2 Phase II

If the project was to continue to a Phase II, the following recommendations should be taken into account. Importantly, this app should not be treated in isolation rather as a valued tool in the big picture of the *FutureBeef* extension program.

A phase II should consider:

- **The cost of the app development and maintenance with a software company.**

The project team recommends further technical and commercial negotiations with *iApps* and at least one other app development firm.

It is also recommended that the app be built for one platform (Apple) first, then if demand is sufficient do an additional build for the Android platform. Development should include a web-based version of the app allowing users who don't have an *iPhone, iPod touch* or *iPad* access to the program. Web support would also facilitate training, updates and data storage.

- **A project team would be required to drive development and marketing of the app.**

An initial estimate would be 20% FTE over 2 years.

- **The same project team should engage and work with a group of producers to test and champion the app in industry.**

A total of 48 producers in the survey indicated that they would be keen to test the app through it's development.

- **The project team should ensure the app is embedded in the grazing land management *FutureBeef* program.**

Suggestions to integrate and get best value out of the app would include integration of the app into the EDGEnetwork GLM revised workshop, links to remote technologies projects and links to AusGRAZE (national Grazing BMP).

- **Development of a series of 'how-to" YouTube clips.**

To ensure the app is well supported the project team in conjunction with the *FutureBeef* team should develop a series of 'how-to' YouTube clips to be embedded in the app's website. The training clips would summarise use of the app, the ABCD land condition framework, forage budgeting and so on. Online blogs and webinars could further boast the relevance of the app and ensure it contributes to the overall aim of greater adoption of more proactive and objective grazing land management.

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10 Appendices

10.1 Appendix 1. Project brief to producers and stakeholders

Department of Employment, Economic Development and Innovation

Investigating a forage budgeting app for northern Australia

Project Background

Currently there exists a number of paper and computer based tools for producers, RD&E personnel, Government compliance officers and advisors to perform forage budgets and monitor grazing land condition. In northern Australia, these tools include those associated with the Stocktake program, the DERM grazing Environmental Risk Management Plan and the Delbessie agreement.

These existing products require a number of steps, both in the paddock and back in the office, using associated tools and techniques (land condition framework, ABCD land condition assessment, pasture photo standards etc) to answer the questions; **"how long will this feed last given the stock in the paddock, desired cattle performance, and desired (or mandatory) ground cover levels"? and "what is the condition of this pasture"?**

Not surprisingly, producers often find it very difficult to get started on forage budgeting and pasture condition assessment given the levels of complexity associated with bringing all the information, skills, tools and techniques together. Therefore, producers and their advisors will likely benefit from the availability of a simple-to-use, integrated application, coupled to a suitable hand held device(s), which assists with forage budgeting and assessment of grazing land condition for both management and compliance purposes.

This project (funded by DEEDI and MLA) will investigate the **viability, likely uptake and benefits of developing a software application (app)** to assist users to assess land/pasture condition, ground cover and calculate forage budgets. The proposed application would run on a selected range of available handheld devices (smart phone, tablets, etc) which can be operated by the majority of producers without intensive training. It is proposed to develop in parallel two versions of the application with the first version being a producer version while the second advanced version would be an upgrade, integrating additional functions, which would be of most use to RD&E personnel and advanced landholder users (such as pastoral company staff or those with a specific interest/need).

The focus of the producer version of the application will be on a limited number of key indicators to increase the adoption of key grazing management practices; namely forage budgeting, estimating ground cover and assessing land/pasture condition. It is important for this version of the application to be a tool well suited to use in the paddock. The software application will need to include capacity for visually and logically prompting the user to enter a field, tick the box, compare photos, enter a number etc in a step by step process.

Decisions on stock numbers are also greatly influenced by the quality of the pasture and so the incorporation of forage/diet quality estimates (e.g. from faecal NIRS), and estimation of animal daily live weight gains, within the same integrated application, will also be investigated.

The device (an off-the-shelf product) hosting the application will require capacity to:

- store photo standards showing dry matter yield (kg/ha), ground cover (%) and land condition (ABCD framework)
- take and store photos
- record and store location (GPS)

The advanced application will need to incorporate 'add-ons' to the producer version which integrates such things as farm mapping programs, VegMachine, 1234 BioCondition indicators and economic spreadsheets. Neither version of the application should be dependent on real-time connectivity to the internet as in-paddock connection is not possible or unreliable in many regions of northern Australia.

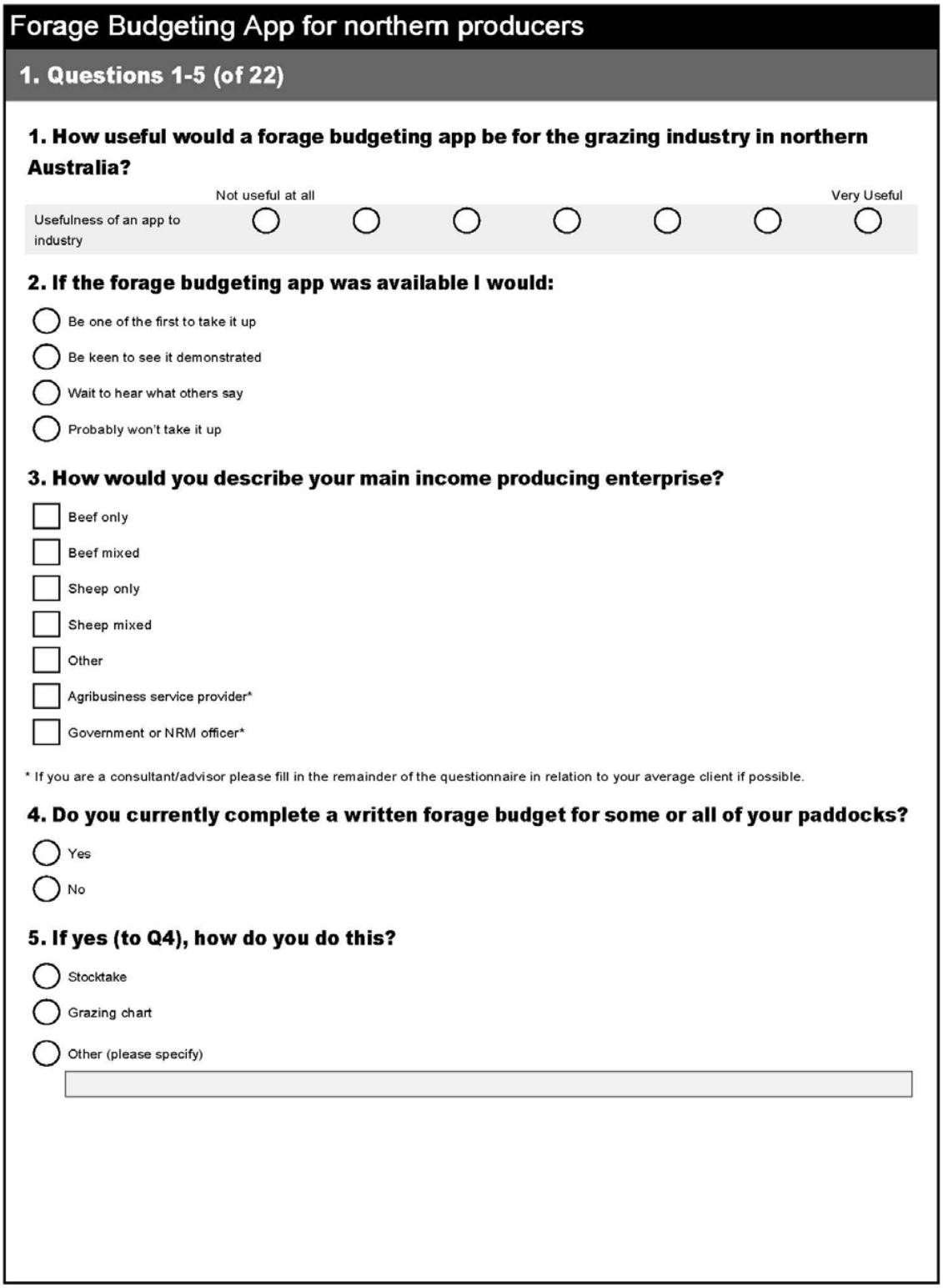
Toward Tomorrow's Queensland | Queensland Government

However, before initiating development of such an application, it is essential to thoroughly investigate the feasibility of doing so, its likely uptake, and its likely impact on industry's adoption of more proactive and effective grazing management. That is what this phase of the project is all about!

If you are interested in knowing more about this proposal or would like to have a say on the practicality and usefulness of the app, please make contact with us.
Jane Hamilton, DEEDI (07) 4622 9915, 0428 103 483, jane.hamilton@deedi.qld.gov.au
Steve Banney, (07) 5485 5102, 0427 161 072, sdb@austarnet.com.au

Please complete our survey online at;
http://www.surveymonkey.com/s/foragebudgetingapp
or complete the following questionnaire and return to Jane Hamilton DEEDI Roma (Po Box 308, Roma, QLD, 4455)

10.2 Appendix 2. Survey questions



Forage Budgeting App for northern producers

1. Questions 1-5 (of 22)

1. How useful would a forage budgeting app be for the grazing industry in northern Australia?

	Not useful at all						Very Useful
Usefulness of an app to industry	○	○	○	○	○	○	○

2. If the forage budgeting app was available I would:

- ○ Be one of the first to take it up
- ○ Be keen to see it demonstrated
- ○ Wait to hear what others say
- ○ Probably won't take it up

3. How would you describe your main income producing enterprise?

- ☐ Beef only
- ☐ Beef mixed
- ☐ Sheep only
- ☐ Sheep mixed
- ☐ Other
- ☐ Agribusiness service provider*
- ☐ Government or NRM officer*

* If you are a consultant/advisor please fill in the remainder of the questionnaire in relation to your average client if possible.

4. Do you currently complete a written forage budget for some or all of your paddocks?

- ○ Yes
- ○ No

5. If yes (to Q4), how do you do this?

- ○ Stocktake
- ○ Grazing chart
- ○ Other (please specify)

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Forage Budgeting App for northern producers

2. Questions 6-10 (of 22)

6. If yes (to Q4) how frequently would you do a forage budget?

times/year

7. Would an app increase either the number of paddocks you conduct a forage budget on or the frequency of your budgets?

- ◯ Yes, because all the tools and information I need will be in one spot
- ◯ Yes, because the budget would be more accurate and/or immediate
- ◯ No

8. If you don't currently do forage budgets would an app help you get started?

- ◯ Yes
- ◯ No, I don't think so

9. Do you currently estimate and record land condition (ABCD or similar) and ground cover percentages for some or all of your paddocks?

- ◯ Yes
- ◯ No

10. If yes (to Q9), how do you do this?

- ◯ Stocktake
- ◯ Other (please specify)

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Forage Budgeting App for northern producers

3. Questions 11-15 (of 22)...you are over half way!

11. Would an app increase either the number of paddocks you monitor or the frequency of your assessments?

- ◯ Yes, because all the tools and information I need is in one spot and results are only recorded once
- ◯ No, I prefer my current system
- ◯ No, I don't see value in monitoring land condition or ground cover

12. If you don't currently do monitoring would an app help you get started?

- ◯ Yes
- ◯ No, I don't think so

13. I believe a suitable forage budgeting app developed with industry consultation will (you can tick more than one box here);

- ☐ Allow me to make more informed stocking rate and land management decisions
- ☐ Save me time on monitoring for either compliance or management
- ☐ Increase the accuracy of my management decisions
- ☐ Make me more money
- ☐ Be another tool I would like to use but don't have time
- ☐ Will be of no value to me

14. If you have an interest in using the app, how much would you spend on purchasing it?

	Less than $50	$50-$100	$100-$200	$200-$300	$300-$400	Over $400
$ spent for App	◯	◯	◯	◯	◯	◯

15. Do you currently own and use a smart phone (e.g. iphone) or tablet (e.g. ipad)?

- ◯ Yes
- ◯ No

If, yes, what brand/model of phone or tablet

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Forage Budgeting App for northern producers

4. Questions 16-22 (of 22)....just about done!

16. If you do not currently own and use a smart phone/tablet, are you planning to own and use such a device within the next two years?

- ◯ Yes
- ◯ No

If, yes, what brand/model of phone or tablet

17. How many apps have you downloaded in the last 12 months?

- ◯ 0
- ◯ 1-3
- ◯ 4-8
- ◯ More than 8

18. If you had to purchase a new device to run this app, how much might you pay?

	Up to $200	$200-$400	$400-$600	$600-$800	$800-$1000	Over $1000	I wouldnt purchase a new devise
$ spent for device	◯	◯	◯	◯	◯	◯	◯

19. What features would you want from the app. Please assign a number from 1 to 8 to signify your priorities (1 is highest priority and 8 is lowest priority) :

	1st Priority	2nd	3rd	4th	5th	6th	7th	8th Priority
Forage budgeting – matching feed supply to feed demand	◯	◯	◯	◯	◯	◯	◯	◯
Assess land condition (ABCD)	◯	◯	◯	◯	◯	◯	◯	◯
Estimate ground cover (%)	◯	◯	◯	◯	◯	◯	◯	◯
Estimate live weight gain (kg/head/day)	◯	◯	◯	◯	◯	◯	◯	◯
Record information for government regulatory compliance	◯	◯	◯	◯	◯	◯	◯	◯
Record information to meet NRM funding/grant obligations	◯	◯	◯	◯	◯	◯	◯	◯
Links to remote sensing data and /or computer mapping software	◯	◯	◯	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯	◯	◯	◯

Other (please specify)

20. What is your nearest town?

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Forage Budgeting App for northern producers

21. Optional Contact details

Name

Address

Phone

Email

22. Follow-Up (we need your contact details for this, Q 21)?

- [ ] I'm keen to test the app and provide comment as you develop it
- [ ] Please notify me if and when the app is ready
- [ ] Please do not contact me in the future about this project

The Department of Employment, Economic Development and Innovation is collecting the information on this esurvey to investigate the potential benefits to industry of developing a forage budgeting 'app'. This information will only be accessed by authorised employees within the department. Some statistical data may be given to Meat and Livestock Australia for the purpose of determining industry interest and benefits of an 'app' for forage budgeting and land monitoring. Your information will not be disclosed to any other parties unless authorised or required by law.

The survey is being conducted using Survey Monkey which is based in the United States of America. Information you provide on this survey will be transferred to Survey Monkey's server in the United States of America. By completing this survey, you agree to this transfer.

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10.3 Appendix 3. Complete survey results

Forage Budgeting App for northern producers

1. How useful would a forage budgeting app be for the grazing industry in northern Australia?

	Not useful at all					Very Useful	Rating Average	Response Count
Usefulness of an app to industry	2.5% (3)	2.5% (3)	3.4% (4)	16.0% (19)	24.4% (29)	20.2% (24)	**31.1% (37)**	5.42	119
							answered question	**119**
							skipped question	**6**

2. If the forage budgeting app was available I would:

	Response Percent	Response Count
Be one of the first to take it up	22.6%	26
Be keen to see it demonstrated	**62.6%**	**72**
Wait to hear what others say	9.6%	11
Probably won't take it up	5.2%	6
	answered question	**115**
	skipped question	**10**

3. How would you describe your main income producing enterprise?

	Response Percent	Response Count
Beef only	**59.0%**	**72**
Beef mixed	11.5%	14
Sheep only	0.8%	1
Sheep mixed	3.3%	4
Other	6.6%	8
Agribusiness service provider*	7.4%	9
Government or NRM officer*	18.0%	22
	answered question	**122**
	skipped question	**3**

4. Do you currently complete a written forage budget for some or all of your paddocks?

	Response Percent	Response Count
Yes	24.1%	27
No	**75.9%**	**85**
	answered question	**112**
	skipped question	**13**

5. If yes (to Q4), how do you do this?

	Response Percent	Response Count
Stocktake	17.1%	6
Grazing chart	**48.6%**	**17**
Other (please specify)	34.3%	12
	answered question	**35**
	skipped question	**90**

6. If yes (to Q4) how frequently would you do a forage budget?

	Response Average	Response Total	Response Count
times/year	**10.72**	**311**	29
		answered question	**29**
		skipped question	**96**

7. Would an app increase either the number of paddocks you conduct a forage budget on or the frequency of your budgets?

	Response Percent	Response Count
Yes, because all the tools and information I need will be in one spot	**61.1%**	**58**
Yes, because the budget would be more accurate and/or immediate	13.7%	13
No	25.3%	24
	answered question	**95**
	skipped question	**30**

8. If you don't currently do forage budgets would an app help you get started?

	Response Percent	Response Count
Yes	**82.2%**	**74**
No, I don't think so	17.8%	16
	answered question	**90**
	skipped question	**35**

9. Do you currently estimate and record land condition (ABCD or similar) and ground cover percentages for some or all of your paddocks?

	Response Percent	Response Count
Yes	**58.0%**	**65**
No	42.0%	47
	answered question	**112**
	skipped question	**13**

10. If yes (to Q9), how do you do this?

	Response Percent	Response Count
Stocktake	23.9%	16
Other (please specify)	**76.1%**	**51**
	answered question	**67**
	skipped question	**58**

11. Would an app increase either the number of paddocks you monitor or the frequency of your assessments?

	Response Percent	Response Count
Yes, because all the tools and information I need is in one spot and results are only recorded once	**73.0%**	**73**
No, I prefer my current system	26.0%	26
No, I don't see value in monitoring land condition or ground cover	1.0%	1
	answered question	**100**

skipped question	**25**

12. If you don’t currently do monitoring would an app help you get started?

	Response Percent	Response Count
Yes	**77.6%**	**66**
No, I don’t think so	22.4%	19
	answered question	**85**
	skipped question	**40**

13. I believe a suitable forage budgeting app developed with industry consultation will (you can tick more than one box here);

	Response Percent	Response Count
Allow me to make more informed stocking rate and land management decisions	**61.5%**	**64**
Save me time on monitoring for either compliance or management	55.8%	58
Increase the accuracy of my management decisions	49.0%	51
Make me more money	19.2%	20
Be another tool I would like to use but don't have time	21.2%	22
Will be of no value to me	7.7%	8
	answered question	**104**
	skipped question	**21**

14. If you have an interest in using the app, how much would you spend on purchasing it?

	Less than $50	$50-$100	$100-$200	$200-$300	$300-$400	Over $400	Rating Average	Response Count
$ spent for App	**30.4% (31)**	28.4% (29)	18.6% (19)	13.7% (14)	3.9% (4)	4.9% (5)	2.47	102

answered question	**102**
skipped question	**23**

15. Do you currently own and use a smart phone (e.g. iphone) or tablet (e.g. ipad)?

	Response Percent	Response Count
Yes	22.2%	26
No	**77.8%**	**91**
If, yes, what brand/model of phone or tablet		26

answered question	**117**
skipped question	**8**

16. If you do not currently own and use a smart phone/tablet, are you planning to own and use such a device within the next two years?

	Response Percent	Response Count
Yes	**50.6%**	**42**
No	49.4%	41
If, yes, what brand/model of phone or tablet		31
answered question		**83**
skipped question		**42**

17. How many apps have you downloaded in the last 12 months?

	Response Percent	Response Count
0	**73.7%**	**73**
1-3	10.1%	10
4-8	9.1%	9
More than 8	7.1%	7
answered question		**99**

skipped question	**26**

18. If you had to purchase a new device to run this app, how much might you pay?

	Up to $200	$200-$400	$400-$600	$600-$800	$800-$1000	Over $1000	I wouldnt purchase a new devise	Rating Average	Response Count
$ spent for device	12.4% (12)	**26.8% (26)**	21.6% (21)	7.2% (7)	6.2% (6)	2.1% (2)	23.7% (23)	3.69	97
							answered question		**97**
							skipped question		**28**

19. What features would you want from the app. Please assign a number from 1 to 8 to signify your priorities (1 is highest priority and 8 is lowest priority):

	1st Priority	2nd	3rd	4th	5th	6th	7th	8th Priority	Rating Average	Response Count
Forage budgeting – matching feed supply to feed demand	**44.2% (42)**	15.8% (15)	11.6% (11)	12.6% (12)	2.1% (2)	4.2% (4)	4.2% (4)	5.3% (5)	2.68	95
Assess land condition (ABCD)	13.1% (11)	**26.2% (22)**	23.8% (20)	10.7% (9)	10.7% (9)	7.1% (6)	4.8% (4)	3.6% (3)	3.38	84
Estimate ground cover (%)	10.6% (9)	20.0% (17)	**32.9% (28)**	18.8% (16)	8.2% (7)	7.1% (6)	2.4% (2)	0.0% (0)	3.25	85
Estimate live weight gain (kg/head/day)	14.6% (13)	**22.5% (20)**	7.9% (7)	19.1% (17)	13.5% (12)	9.0% (8)	10.1% (9)	3.4% (3)	3.79	89
Record information for government regulatory compliance	5.7% (5)	8.0% (7)	8.0% (7)	9.1% (8)	17.0% (15)	**22.7% (20)**	19.3% (17)	10.2% (9)	5.20	88
Record information to meet NRM funding/grant obligations	4.8% (4)	7.1% (6)	7.1% (6)	11.9% (10)	19.0% (16)	**23.8% (20)**	19.0% (16)	7.1% (6)	5.17	84
Links to remote sensing data and /or computer mapping software	4.7% (4)	4.7% (4)	10.5% (9)	16.3% (14)	**26.7% (23)**	16.3% (14)	18.6% (16)	2.3% (2)	4.91	86
Other	23.5% (4)	0.0% (0)	0.0% (0)	0.0% (0)	5.9% (1)	17.6% (3)	0.0% (0)	**52.9% (9)**	5.82	17
								Other (please specify)		17
									answered question	**102**
									skipped question	**23**

20. What is your nearest town?

	Response Count
	113
answered question	**113**
skipped question	**12**

21. Optional Contact details

	Response Percent	Response Count
Name	**98.8%**	**82**
Address	81.9%	68
Phone	83.1%	69
Email	86.7%	72
answered question		**83**
skipped question		**42**

22. Follow-Up (we need your contact details for this, Q 21)?

		Response Percent	Response Count
I'm keen to test the app and provide comment as you develop it		**64.9%**	**48**
Please notify me if and when the app is ready		56.8%	42
Please do not contact me in the future about this project		6.8%	5
		answered question	**74**
		skipped question	**51**

Page 1, Q5. If yes (to Q4), how do you do this?

1	?	Aug 2, 2011 8:58 AM
2	Drive around paddock	Aug 2, 2011 8:56 AM
3	GLM Toolkit	Aug 2, 2011 8:47 AM
4	GLM type usual assessment	Aug 2, 2011 8:46 AM
5	I keep my own record of pasture	Aug 2, 2011 8:45 AM
6	Photos	Jul 1, 2011 11:18 AM
7	visual / observation / experience	Jul 1, 2011 11:13 AM

Page 1, Q5. If yes (to Q4), how do you do this?		
8	MS Excell	Apr 20, 2011 1:41 PM
9	By site	Apr 18, 2011 12:22 PM
10	own method based on GLM / Stocktake	Mar 21, 2011 8:40 AM
11	have done them before and know how to although assessing in your head is as good as anything.	Mar 16, 2011 10:02 AM
12	Photograph.	Mar 4, 2011 9:32 AM

Page 2, Q6. If yes (to Q4) how frequently would you do a forage budget?		
1	1	Aug 2, 2011 9:16 AM
2	4	Aug 2, 2011 9:11 AM
3	2	Aug 2, 2011 9:09 AM
4	1	Aug 2, 2011 9:05 AM
5	4	Aug 2, 2011 8:56 AM
6	3	Aug 2, 2011 8:51 AM
7	1	Aug 2, 2011 8:47 AM
8	2	Aug 2, 2011 8:45 AM
9	0	Jul 11, 2011 9:49 AM
10	3	Jul 1, 2011 12:52 PM
11	7	Jul 1, 2011 11:33 AM
12	4	Jun 9, 2011 8:04 AM

Page 2, Q6. If yes (to Q4) how frequently would you do a forage budget?		
13	2	May 18, 2011 9:41 AM
14	2	May 11, 2011 3:11 PM
15	1	Apr 23, 2011 7:54 AM
16	160	Apr 20, 2011 3:51 PM
17	12	Apr 20, 2011 1:43 PM
18	2	Apr 20, 2011 10:05 AM
19	52	Apr 18, 2011 12:25 PM
20	12	Apr 14, 2011 8:41 PM
21	1	Mar 24, 2011 9:39 AM
22	2	Mar 21, 2011 1:52 PM
23	1	Mar 21, 2011 8:41 AM
24	2	Mar 16, 2011 11:17 AM
25	1	Mar 16, 2011 10:03 AM
26	12	Mar 16, 2011 9:59 AM
27	12	Mar 16, 2011 9:19 AM
28	1	Mar 9, 2011 6:25 PM
29	4	Mar 3, 2011 11:37 AM

Page 2, Q10. If yes (to Q9), how do you do this?

1	visually and photos	Aug 2, 2011 9:19 AM

Page 2, Q10. If yes (to Q9), how do you do this?		
2	Gut feeling / by eye	Aug 2, 2011 9:16 AM
3	My head	Aug 2, 2011 9:12 AM
4	every time we visit an area	Aug 2, 2011 9:11 AM
5	Grass check	Aug 2, 2011 9:05 AM
6	?	Aug 2, 2011 8:58 AM
7	Ad Hoc	Aug 2, 2011 8:54 AM
8	KG por hect	Aug 2, 2011 8:53 AM
9	Hands on constant surveilance & experience & local knowledge - 4th generation on property	Aug 2, 2011 8:49 AM
10	GLM Toolkit	Aug 2, 2011 8:47 AM
11	my own records	Aug 2, 2011 8:45 AM
12	by eye	Jul 27, 2011 6:58 PM
13	Experience at how long paddock last in previous years and look of country	Jul 1, 2011 1:00 PM
14	keep checking and planting	Jul 1, 2011 12:58 PM
15	ERMP	Jul 1, 2011 11:53 AM
16	rotational grazing charts	Jul 1, 2011 11:33 AM
17	in head	Jul 1, 2011 11:25 AM
18	just records	Jul 1, 2011 11:24 AM
19	ERMP (Northern property)	Jul 1, 2011 11:22 AM
20	visual / experience	Jul 1, 2011 11:13 AM
21	observation and monitoring	Jul 1, 2011 11:03 AM

Page 2, Q10. If yes (to Q9), how do you do this?		
22	in my herd	Jul 1, 2011 10:20 AM
23	eyebolling and gut feeling	Jul 1, 2011 10:07 AM
24	take photos at monitoring at sites	Jul 1, 2011 10:00 AM
25	Monitoring Points	Jul 1, 2011 9:55 AM
26	Own system	Jun 4, 2011 5:14 PM
27	photo monitoring, visial estimates	May 18, 2011 9:41 AM
28	Estimation of kg/ha within State Controlled Road Reserve for Fire threat management	Apr 27, 2011 4:48 PM
29	grass monitoring site	Apr 23, 2011 7:54 AM
30	Visual estimate 30 years experience/rainfall/ growing time/maturing seed heads/grass cycles/grazing while growing	Apr 20, 2011 7:12 PM
31	Data enetered into SSheet	Apr 20, 2011 1:43 PM
32	Site and memory	Apr 18, 2011 12:25 PM
33	GLM+/$avannahPlan adapted model	Apr 18, 2011 11:40 AM
34	Grass check sites	Apr 14, 2011 8:41 PM
35	I don't own a property but do ground cover assessments as part of my work	Apr 13, 2011 12:52 PM
36	done by consultants	Apr 4, 2011 9:18 AM
37	visual - but not recorded	Mar 31, 2011 5:38 PM
38	As per GLM	Mar 30, 2011 4:24 PM
39	experience Stocktake	Mar 24, 2011 9:39 AM
40	visual	Mar 24, 2011 9:30 AM
41	Grass Check	Mar 21, 2011 1:52 PM

Page 2, Q10. If yes (to Q9), how do you do this?		
42	own method based on Qld Dpi Grass checka method	Mar 21, 2011 8:41 AM
43	watching your land	Mar 16, 2011 2:56 PM
44	Property Management Plan	Mar 16, 2011 11:02 AM
45	through monitoring sites	Mar 16, 2011 10:03 AM
46	basal area monitoring, photo points	Mar 16, 2011 9:19 AM
47	Landscape Function Analysis; Grasscheck as well as ABCD (depends on situation)	Mar 9, 2011 6:25 PM
48	weed managment program	Mar 8, 2011 10:47 PM
49	Monitoring Sites	Mar 7, 2011 3:17 PM
50	not written	Mar 7, 2011 3:12 PM
51	Land Condition Phot Standards for the Burdekin Dry Tropics Rangelands	Mar 2, 2011 2:48 PM

Page 3, Q15. Do you currently own and use a smart phone (e.g. iphone) or tablet (e.g. ipad)?		
1	Samsungs	Aug 2, 2011 8:59 AM
2	Iphone	Jul 18, 2011 9:11 AM
3	iphone 3gs	Jul 11, 2011 9:50 AM
4	iphone	Jul 1, 2011 12:50 PM
5	iphone	Jul 1, 2011 11:27 AM
6	ipone and ipad	Jul 1, 2011 11:24 AM
7	tablet	Jul 1, 2011 11:21 AM

Page 3, Q15. Do you currently own and use a smart phone (e.g. iphone) or tablet (e.g. ipad)?		
8	because of lack of service in area	Jul 1, 2011 11:01 AM
9	iphone	Jul 1, 2011 10:06 AM
10	Blackberry 3800 Torch	Jun 2, 2011 3:48 PM
11	Iphone 3G	Jun 2, 2011 11:11 AM
12	I,4	May 18, 2011 9:43 AM
13	tablet	Apr 27, 2011 4:48 PM
14	X plorie	Apr 20, 2011 4:01 PM
15	iphone	Apr 20, 2011 10:06 AM
16	HTC Touch	Apr 19, 2011 10:00 AM
17	motorola	Apr 18, 2011 11:30 AM
18	Apple	Apr 14, 2011 8:43 PM
19	Blackberry	Mar 28, 2011 8:20 PM
20	I Pad - Apple	Mar 24, 2011 9:39 AM
21	Iphone 4	Mar 24, 2011 9:23 AM
22	i-phone 4	Mar 16, 2011 11:18 AM
23	Motorola	Mar 16, 2011 11:03 AM
24	iphone3	Mar 16, 2011 9:19 AM
25	not yet	Mar 8, 2011 10:49 PM
26	Apple iphone	Mar 2, 2011 2:49 PM

Page 4, Q16. If you do not currently own and use a smart phone/tablet, are you planning to own and use such a device within the next two years?

1	Possibly	Page 77 of 125 Aug 2, 2011 9:17 AM

Page 4, Q16. If you do not currently own and use a smart phone/tablet, are you planning to own and use such a device within the next two years?		
2	next G	Aug 2, 2011 9:16 AM
3	IPhone	Aug 2, 2011 9:10 AM
4	Maybe	Aug 2, 2011 8:52 AM
5	Upgraded iphone	Jul 11, 2011 10:02 AM
6	not sure yet	Jul 1, 2011 12:55 PM
7	iphone	Jul 1, 2011 12:53 PM
8	nokia or apple iphone	Jul 1, 2011 11:52 AM
9	not sure yet probably an Apple product	Jul 1, 2011 11:31 AM
10	iphone	Jul 1, 2011 11:28 AM
11	0749832381	Jun 19, 2011 4:40 PM
12	apple iphone	Jun 9, 2011 8:06 AM
13	?	Jun 8, 2011 4:26 PM
14	iPad	Jun 4, 2011 5:17 PM
15	do not know	May 11, 2011 3:18 PM
16	Do smart phone work in isolated areas mobiles do not	Apr 20, 2011 7:18 PM
17	motorola defy	Apr 20, 2011 1:46 PM
18	A good one	Apr 18, 2011 12:34 PM
19	Not sure	Apr 18, 2011 11:45 AM
20	android	Apr 13, 2011 12:56 PM
21	to be decided	Apr 4, 2011 9:24 AM

Page 4, Q16. If you do not currently own and use a smart phone/tablet, are you planning to own and use such a device within the next two years?		
22	just got a new phone	Mar 24, 2011 9:27 AM
23	I Phone	Mar 21, 2011 2:19 PM
24	no idea? will be recommended by AAco IT dept.	Mar 21, 2011 11:21 AM
25	we will never be able to get one where we live to far isolated out to work	Mar 16, 2011 2:59 PM
26	haven't decided	Mar 9, 2011 6:29 PM
27	I phone or Ipad	Mar 8, 2011 10:55 PM
28	IPhone Apple	Mar 7, 2011 3:16 PM
29	I Phone	Mar 7, 2011 2:46 PM
30	Not sure	Mar 3, 2011 12:41 PM
31	iPhone	Mar 3, 2011 11:41 AM

Page 4, Q19. What features would you want from the app. Please assign a number from 1 to 8 to signify your priorities (1 is highest priority and 8 is lowest priority) :		
1	I think it is worth developing for younger people who have not had an extensive farm background	Aug 2, 2011 9:04 AM
2	Plant ID, Weed DI	Aug 2, 2011 8:54 AM
3	Maybe some kind ofnotepad to p/up other issues whilst out in the paddock eg. broken wire, water problem, weeds identified, mining co breach etc	Jul 1, 2011 11:31 AM
4	Pheonix	Jul 1, 2011 11:19 AM
5	I do these surveys as we drive around all year, but as I try to keep up with the younger generation I can see that a lot of information (not only this) should be recorded to enable us to work more as a team & everyone is aware of how others see things	Jul 1, 2011 9:58 AM
6	instead of forage budgeting, how much fuel loading kg/ha for fire threat reduction	Apr 27, 2011 4:53 PM

Page 4, Q19. What features would you want from the app. Please assign a number from 1 to 8 to signify your priorities (1 is highest priority and 8 is lowest priority) :		
7	never used an app before but assume it would rapid inpaddock recording of past levels, measures of biodiversity, etc	Apr 20, 2011 1:46 PM
8	time lapse history of photos	Apr 18, 2011 11:32 AM
9	I think ALL of the above would be good.	Mar 30, 2011 4:32 PM
10	Managing future paddock rotations	Mar 28, 2011 8:23 PM
11	If involved would probably use all	Mar 24, 2011 9:27 AM
12	GPS Capabilities	Mar 21, 2011 2:19 PM
13	long term carrying capacity, rainfall data	Mar 21, 2011 11:21 AM
14	Updating all aspects of Property Management Plan at all times if needed.	Mar 16, 2011 11:06 AM
15	Collate and record land monitoring data and photos, then link back into software on computer for reviewing without any extra steps. ie all data linked to each monitoring point.	Mar 16, 2011 9:23 AM
16	teaching rangeland management students	Mar 9, 2011 6:29 PM
17	Monitor weeds with the use of GPS app.	Mar 8, 2011 10:55 PM

Page 4, Q20. What is your nearest town?		
1	Brisbane	Aug 13, 2011 12:20 AM
2	Mount Molloy qld	Aug 2, 2011 9:20 AM
3	Forsayth	Aug 2, 2011 9:17 AM
4	Mareeba	Aug 2, 2011 9:16 AM
5	Georgetown	Aug 2, 2011 9:15 AM

Page 4, Q20. What is your nearest town?		
6	Malanda	Aug 2, 2011 9:13 AM
7	Forsayth	Aug 2, 2011 9:12 AM
8	Forsayth	Aug 2, 2011 9:10 AM
9	Georgetown	Aug 2, 2011 9:08 AM
10	Einasleigh	Aug 2, 2011 9:07 AM
11	Georgetown	Aug 2, 2011 9:04 AM
12	Einasleigh	Aug 2, 2011 9:03 AM
13	Mt Surprise	Aug 2, 2011 9:02 AM
14	Mareeba	Aug 2, 2011 9:00 AM
15	Georgetown	Aug 2, 2011 8:59 AM
16	Croydon	Aug 2, 2011 8:57 AM
17	Georgetown	Aug 2, 2011 8:55 AM
18	Mount Surprise	Aug 2, 2011 8:54 AM
19	Georgetown	Aug 2, 2011 8:52 AM
20	Einasleigh	Aug 2, 2011 8:51 AM
21	Georgetown	Aug 2, 2011 8:48 AM
22	Proston	Jul 19, 2011 10:05 PM
23	Chinchilla	Jul 18, 2011 9:12 AM
24	Townsville	Jul 11, 2011 10:02 AM
25	Emerald	Jul 1, 2011 1:01 PM

Page 4, Q20. What is your nearest town?		
26	Emerald	Jul 1, 2011 12:59 PM
27	Emerald	Jul 1, 2011 12:58 PM
28	Emerald	Jul 1, 2011 12:56 PM
29	Emerald	Jul 1, 2011 12:55 PM
30	Bairsdale Vic	Jul 1, 2011 12:53 PM
31	Emerald	Jul 1, 2011 12:51 PM
32	Charters Towers	Jul 1, 2011 12:50 PM
33	Emerald	Jul 1, 2011 12:49 PM
34	Emerald	Jul 1, 2011 11:56 AM
35	Middlemount	Jul 1, 2011 11:54 AM
36	Springsure	Jul 1, 2011 11:52 AM
37	Springsure	Jul 1, 2011 11:34 AM
38	Emerald	Jul 1, 2011 11:32 AM
39	Emerald	Jul 1, 2011 11:31 AM
40	Emerald/Coment Alpha/Tambo	Jul 1, 2011 11:28 AM
41	comet	Jul 1, 2011 11:26 AM
42	Clermont	Jul 1, 2011 11:25 AM
43	Middlemount	Jul 1, 2011 11:23 AM
44	Cooma	Jul 1, 2011 11:21 AM
45	Springsure	Jul 1, 2011 11:19 AM

Page 4, Q20. What is your nearest town?		
46	Rockyhampton	Jul 1, 2011 11:16 AM
47	Emerald	Jul 1, 2011 11:10 AM
48	Springsure	Jul 1, 2011 11:07 AM
49	Rockhampton	Jul 1, 2011 11:02 AM
50	Rockhampton	Jul 1, 2011 11:00 AM
51	Rockhampton	Jul 1, 2011 10:22 AM
52	Rockhampton	Jul 1, 2011 10:18 AM
53	Moura	Jul 1, 2011 10:15 AM
54	Rockhampton	Jul 1, 2011 10:13 AM
55	Yeppoon	Jul 1, 2011 10:11 AM
56	Theodore	Jul 1, 2011 10:09 AM
57	Yaamba	Jul 1, 2011 10:07 AM
58	Rockhampton	Jul 1, 2011 10:04 AM
59	Moura	Jul 1, 2011 9:58 AM
60	Clermont	Jun 19, 2011 4:40 PM
61	Einasleigh	Jun 14, 2011 9:27 AM
62	Gladstone	Jun 9, 2011 8:06 AM
63	Fernvale	Jun 8, 2011 4:26 PM
64	Mundubbera	Jun 4, 2011 5:17 PM
65	Property Location: Killarney 4373	Jun 2, 2011 3:53 PM

Page 4, Q20. What is your nearest town?		
66	Alice Springs	May 18, 2011 9:48 AM
67	Kairi	May 13, 2011 11:28 AM
68	McKinlay via Julia Creek	May 11, 2011 3:18 PM
69	Barcaldine	Apr 27, 2011 4:53 PM
70	Cloncurry	Apr 23, 2011 8:00 AM
71	Julia creek	Apr 20, 2011 7:18 PM
72	Longreach	Apr 20, 2011 4:34 PM
73	4725	Apr 20, 2011 1:46 PM
74	winton	Apr 20, 2011 11:42 AM
75	Longreach	Apr 20, 2011 10:10 AM
76	MCKINLAY QLD	Apr 19, 2011 9:13 PM
77	Cloncurry	Apr 19, 2011 10:02 AM
78	CALLIOPE	Apr 18, 2011 12:34 PM
79	Mitchell	Apr 18, 2011 11:48 AM
80	Mt Garnet	Apr 18, 2011 11:45 AM
81	rathdowney	Apr 18, 2011 11:32 AM
82	Dirranbandi	Apr 14, 2011 8:46 PM
83	Brisbane	Apr 13, 2011 12:56 PM
84	Toowoomba	Apr 4, 2011 9:24 AM
85	Mungallala	Apr 2, 2011 5:27 PM

Page 4, Q20. What is your nearest town?		
86	roma	Mar 31, 2011 5:41 PM
87	Windorah	Mar 30, 2011 4:32 PM
88	TOWNSVILLE	Mar 29, 2011 10:20 AM
89	Thangool	Mar 28, 2011 8:23 PM
90	Mundubera	Mar 24, 2011 9:41 AM
91	Gin Gin	Mar 24, 2011 9:37 AM
92	Boonah	Mar 24, 2011 9:31 AM
93	Gympie	Mar 24, 2011 9:30 AM
94	Kingaroy	Mar 24, 2011 9:27 AM
95	Brooweena	Mar 24, 2011 9:24 AM
96	Tennant Creek	Mar 21, 2011 2:19 PM
97	Tennant Creek, NT	Mar 21, 2011 11:21 AM
98	Laura, Coen, Chillagoe,Gayndah	Mar 18, 2011 3:55 PM
99	town as such (townsville)	Mar 16, 2011 2:59 PM
100	normanton	Mar 16, 2011 11:21 AM
101	Croydon	Mar 16, 2011 11:06 AM
102	Croydon	Mar 16, 2011 10:05 AM
103	Georgetown	Mar 16, 2011 10:03 AM
104	Rockhampton	Mar 16, 2011 9:23 AM
105	Cambboya	Mar 9, 2011 6:29 PM

Page 4, Q20. What is your nearest town?	
106	Darwin NT
107	Elliot
108	Katherine
109	Katherine
110	Katherine
111	Biloela
112	Emerald
113	Townsville