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# Technology adoption by rural women in Queensland, Australia: Women driving technology from the homestead for the paddock

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ABSTRACT

The adoption of Precision Livestock Farming (PLF) technologies to optimize beef cattle production in Northern Australia promises to boost the sector's productivity and profitability. This study examines the roles of grazier women in particular in the current use of and further adoption of on farm technology. It adds to the broader literature on women in agriculture, briefly examining feminist theory and then discussing eco feminism, capital resource ownership, and rural residency. The study considered the adoption of specific rural technologies (such as remote cameras, remote weather stations, bore cameras, and other livestock management systems), but found the current use of these tools to be limited. The limited spread of new rural technologies strongly supports the aim of this study, and ultimately, raises the question of who is driving rural technology diffusion and adoption amongst cattle producers. Data collected through 60 conversational interviews and from 141 participants of an online survey established the centrality of women graziers' roles. The research found that women use most components of online technology three times more often than men. While they were sometimes reluctant to take on the digital homestead tasks, by doing so they feel empowered and valued in their work. More importantly, the study found that as technology diffuses into rural settings and is adopted by grazier women, it is modifying gender divisions, specifically away from traditional separate roles and towards productive partnerships in farming families. Those advocating the further adoption of the new PLF technologies need to be mindful of the women graziers' role as busy users and joint decision makers.


## 1. Introduction

New livestock management systems require graziers to manage technology from the station homestead, potentially keeping them from performing outside operations. This research project considers that male graziers may not want to forego paddock and stock work, and station maintenance tasks to complete computer based technology operations from within the homestead (Pannell and Vanclay, 2011). This study hypothesizes that remote livestock management technology systems operation may fall to the women in the pastoral partnership.

This paper aims to establish the extent to which rural women use technology and it explores their views on their role in managing emerging livestock management tools. The key objective of the study is to seek the views of rural women on adopting rural technology and its role in the future. The paper draws on in-depth empirical research about women using technology in rural settings to explore whether or not women are the key to diffusion of farm related digital technology. The article begins with an overview of women in agriculture, which includes feminist theory in a broad sense. Eco feminism, capital resource ownership and rural residency are then discussed. Following the discussion on gender, we examine three important topics related to technology adoption in a rural setting. Firstly, we discuss factors affecting technology adoption and the scale of property size and distances involved in rural Queensland, as well as problems faced by graziers. Secondly, we give an overview of precision agriculture focusing on production benefits, and thirdly, we introduce the Australian cattle industry and its importance to Queensland graziers. The paper presents a case study of precision farming in Australia. The social position of rural women who are isolated by large scale farming, and in turn rely on technology for communication, business management and productivity related tasks, shapes the understanding of problems associated with innovation and the adoption of rural technology

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amongst beef producers in Queensland. The study is viewed as having broader implications for women in other dispersed rural settings both in Australia and elsewhere.

## 2. Women in agriculture

A focus on women in agriculture has developed over time by exploring social inequality based on gender through the application of Marxist and political economic perspectives (Little, 2009). Although gender was not central to many earlier studies, women's roles were often previously defined in small scale commodity production and survival of the family farm (Bryant and Pini, 2006; Little, 2009). However, a vast amount of research has evolved around eco feminism, which examines women's relationship to the environment and nature (for more about eco feminism read Bryant and Pini (2006) who take a gender lens to agricultural biotechnology and discuss both the virtues and criticisms of eco feminism). In rural Australia, women have been described as invisible. Rural women have appeared infrequently as leaders in producer groups, commodity boards and agricultural bureaucracies or in agricultural research and development (Bryant and Pini, 2006). Until recently, women's work, characteristically secretarial work, feeding the farm workers, caring for house animals and providing emergency labor, was not regarded as important to the business (Alston and Wilkinson, 1998; Little, 2009). In addition, women tended to marry into the farming family, and as such, men were regarded as the owner of the capital resources, and hence, the owners of decision making (Bock, 2006). Capital resources include access to land, credit, education and training, and decision making (Bryant and Pini, 2006). Bryant and Pini (2006) claim that women's "exclusion from farming capital has critical implications for women's position in the public sphere of agriculture for, as feminist have argued, the gendering of private space cannot be segregated from the gendering of public space". In addition, Little (2009) argues that rural women were "double disadvantaged". Firstly as 'rural residents', suffering problems of remoteness and poor services; and secondly because they were women who were responsible only for the "domestic reproduction of the household". Penley (1991) supports Little's views, writing of "women's lack of social and economic equality and having to manage double duty work and domestic life" (Little, 2009; Penley, 1991). To escape the disadvantages of "rural residency" suffered by their mothers, younger generation women have worked off farm (Bock, 2006).

Bryant and Pini (2006) consider that there is a link between gender and technology in rural sociology, especially where the technology is based around heavy machinery and information and communication technologies (see Towards an Understanding of Gender and Capital in Constituting Biotechnologies in Agriculture for a wider view (Bryant and Pini, 2006)). Saugeres (2002a) suggests that "male farmers use agricultural technology to reinforce patriarchal ideologies, which marginalize and exclude women from farming". The author also posits that "tractors have become a symbol of masculine power and domination over women" (Saugeres, 2002a). The same researcher further explored this issue in another French farming community, and found that men have a natural affinity with farming machinery, and argues that this affinity excludes women from rural technology (Saugeres, 2002b). However, "through showing how women are associated with particular parts of the business, and their role in farming diversification", Little (2009) suggests that women can be identified as dominant farmers; this theme became an emphasis of 1990s research. It was around this time that farming families turned to pluriactivity or diversification and women engaged in non-agricultural work off the farm (Gasson and Winter, 1992; Saugeres, 2002a). As well as representing a fundamental change in women's economic status in family farms, off farm work encouraged equal status amongst farming men and women (Bock, 2006).

More recently, women's roles in farming families have increasingly been recognized as important and necessary (Farmar-Bowers, 2010). Claridge (1998) and other researchers argue that women have valuable skills and attributes to bring to decision making, and that women want to feel empowered, and that they want to increase their skills in leadership and determining actions for the future (Bock, 2006; Farmar-Bowers, 2010; Pannell and Vanclay, 2011; Umrani and Ghadially, 2003). Rickson and Daniels (1999) posit that although the dimensions of power between men and women are not equal, women are seen to be important as decision makers within the rural family. Rural women driving the adoption of technology may help women achieve their goals of leadership and equality in the farming family (Alston and Wilkinson, 1998). However, the complexity and diversity of women's activity on farms may also challenge the masculinity of farming men, who associate masculinity and leadership with technology use (mainly associated with heavy machinery) and the agrarian values of control, toughness, hard work, self denial and of pride and pleasure of work in farming as a way of life (Brandth, 1995; Coldwell, 2007; Saugeres, 2002a). That women can attune themselves to a vast array of farming tasks, which also challenges farmers' masculinity, is in accord with the work of Saugeres (2002b) whose research on the constructions of embodiment in farming families "explores how the discursive representation of women's bodies both reproduces and legitimates unequal gender relations between women and men on the farm". The study concludes that not only do women participate in work that is as physically arduous as men, it is also equally valuable. Therefore, women using homestead based technology to farm may reduce a proposed threat to male grazier's masculinity and the traditional concept of gendered embodied farm work may be maintained.

Using technology (being 'tech savvy') in livestock management reduces women's dependency on male family members and increases self esteem and confidence; as well, it expands women's choices, enabling them to make informed decisions (Umrani and Ghadially, 2003). Haraway (1997) views technology as having a positive influence rather than a negative influence in the post gender world. Pannell and Vanclay (2011) and Alston (1995) argue that women in agriculture are managers, administrators and stock workers, as well as wives, mothers and community workers who contribute significantly to agricultural production. Penley (1991) and van Zoonen (1992) support women using technology to complete such tasks and claim it may be liberating for them. Studies in Australia over the last decade argue "women influence strategic planning, production and marketing policies" in farm management, and that they are "strategic agents in influencing the decisions" in relation to farm outputs (Bock, 2006; Pannell and Vanclay, 2011). Farmar-Bowers (2010) agrees that rural women's contribution to strategic decisions in agriculture is very important to rural livelihoods. Rural women want to be included in decision making, they want to be involved in "information gathering that will have an impact on their livelihoods, their workloads, and the future of their families and communities" (Pannell and Vanclay, 2011). As technology adoption in rural settings becomes more popular, the present study on technology adoption by rural women may help to highlight a shift away from previously studied gender divisions, towards productive partnerships in farming families. This study seeks to contribute to a growing body of research focusing on the adoption of precision agriculture technology. It considers the extent to which rural women use technology and their views on their roles in managing these emerging livestock management tools.

## 3. Technology adoption

The first element of concern regarding rural technology adoption is that cattle graziers need to consider several parameters when making management decisions such as the size of the station, the distance to water points, and the effects of weather on pastures to maintain the herd's health and welfare (Berckmans, 2004; Holloway et al., 2014; McKenzie, 2013; Wathes et al., 2001). In addition, increases in cattle station size and/or increasing stock numbers add to the grazier's administrative, technical, organizational, and logistical workload (Berckmans, 2004; Tomkins and O'Reagain, 2007). Commonly graziers make decisions via direct observation of cattle management parameters (e.g. water levels, rainfall, and distance to bores, National Livestock Identification Systems (NLIS) data recording), as well as visual cues from stock (McKenzie, 2013). Direct observations are usually labor intensive, both in time and resources (Tomkins and O'Reagain, 2007). More recently, technology has moved towards a more hands off approach, developing the notion of animal–technology relationships, which when embraced has both economic advantages for farming as well as lifestyle advantages for farmers (Holloway et al., 2014). Adopting Remote Livestock Management (RLM) systems can help to reduce time and costs associated with direct observation and hands on farming. In addition, as noted in the automated diary industry, rural technologies claim to reduce the drudgery of conventional farming practices (Holloway et al., 2014; Meat and Livestock Australia, 2011).

A second element of concern is that fewer younger people are entering the agricultural industry, resulting in a shortage of suitably qualified stockmen as well as a lack of suitable candidates for succession of the business (Redfurn, 2012; Wathes et al., 2008). Australia's aging agricultural labor force is a further driver towards adoption of RLM technologies. The use of RLM systems may help to overcome the constraints of both fewer workers and less experienced employees (Wathes et al., 2008). However, adopting RLM technology changes pastoral practices, which may require the grazier to spend more time in the homestead, learning and using the technology (Tey and Brindal, 2012). When considering livestock management technology, Reichardt et al. (2009) found that "a large amount of the graziers' time is spent getting used to the technology, and learning how to use it". Reichardt et al. (2009) also found that successful application was only achieved when PLF systems had one dedicated user. Additionally, graziers are traditionally known to be "time poor and uninclined to work inside" or on one single job, supporting a shift towards rural women managing technology (Pannell and Vanclay, 2011).

Many researchers have investigated the adoption of technology (Aubert et al., 2012). For example Daberkow and McBride (2003) identified farm size and location as having a positive impact on technology adoption "the larger the farm the higher the adoption rate", as did Adrian et al. (2005). Likewise, farms located in an area with high product homogeneity i.e. cropping, have been shown to be conducive to high uptake of product suited technology (Daberkow and McBride, 2003). Furthermore, access to professional support and complementarity of the technology to livestock production will affect adoption (Daberkow and McBride, 2003). For example, a farm using National Livestock Identification System (NLIS) technology may readily adopt the NLIS scanning wand, which automatically scans and sends data to a computer.

Feder and Umali (1993) cited the borrowing capacity of the farm as an important criterion to PA technology adoption and Mackrell et al. (2009) identified the male grazier as the main decision maker (as cited in Aubert et al., 2012). However, Farmar-Bowers (2010) found that women are also involved in making decisions about farming practices and that their decisions are made with the family in mind rather than just profits. Further studies have described age as a factor in technology adoption, with an increase in age likely to reduce the uptake of technology (Daberkow and McBride, 2003; Kutter et al., 2011). However, the age of participants in this study somewhat disputes this. Furthermore, attitude and lower education were likely to be barriers to adoption (Adrian et al., 2005; Aubert et al., 2012). Consequently, the widely accepted Technology Adoption Model (TAM) (Davis, 1989), which considers perceived ease of use and perceived usefulness, states that above all, for technology to be adopted it must be both easy to use, and useful.

## 4. Precision agriculture

The shift to precision agriculture technology began in the early 80's. However it was not until the 1990s where its adaptation to livestock management emerged (Brase, 2005). Remote Livestock Management (RLM) systems encompass Precision Livestock Farming (PLF), Precision Agriculture (PA) and on farm technologies, such as accounting and stock management software help graziers to save time, cut costs and increase profitability, as well as better manage pastures on large scale cattle stations in Australia (Meat and Livestock Australia, 2013; Tey and Brindal, 2012). Wathes et al. (2008) define PLF as "the management of livestock production using the principles and technology of process engineering". Similarly, the National Research Council (1999) defines precision agriculture (PA) as "a management strategy that uses information technology to bring data from multiple sources to bear on decisions associated with … production". Remote livestock management (RLM) systems remotely monitor water stations, weather stations, animal weights, calving and other data involved in livestock management (Meat and Livestock Australia, 2013). RLM technology is emerging as a recognized contributor to efficient and environmentally sustainable grazing practices (Aubert et al., 2012; Tey and Brindal, 2012).

## 5. The Australian cattle industry

Australian cattle producers supply 96% of beef products to the Australian market, and 4% to international markets (MLA, 2012b). Rising per person incomes and urbanization will see almost half of the world's meat production consumed in developing countries by 2020 (ABARES, 2012). The trend for consumption of animal products has seen large increases from within the BRIC countries (Brazil, Russia, India and China), as well as the Middle East and South East Asia (Gregory, 2007 & FAO, 2009 cited in ABARES, 2012). A positive economic outlook for the BRICs, the Middle East, and South East Asia, and the high food security value of Australian produce, are expected to result in increased demand for Australian beef products (ABARES, 2012). Further, if food security is imperiled in other exporting countries due to disease (for example, where there is the threat of foot and mouth disease), the ensuing shortage may cause higher demand for processed meat products, particularly beef products, from Northern Australia (ABARES, 2012). Increased demand for beef products may create an opportunity to boost production, which could heighten profitability. Together these concerns are likely to create a demand for livestock management technology.

Some of these studies may have assumed that the woman is the technology user and decision maker, but none of them (with the exception of Farmar-Bowers, 2010) has specifically surveyed women. Very few studies have considered the woman's view on the adoption of livestock management technology, which is the focus of this paper.

## 6. Method

### 6.1. Overview

The research methodology used a mixed method data collection strategy (Dillman et al., 2009; Saunders et al., 2009). The study was completed in Queensland, Australia's highest cattle producing state (MLA, 2012a). Data were collected firstly, through conversational interviews with attendees of the Ag-Grow QMIX Field Day (a three day agricultural event held in Emerald in the Central Highlands of Queensland); and secondly, through an online survey completed by members of the Queensland Isolated Children's and Parents' Association (ICPA). The ICPA is "a voluntary, not for profit, apolitical organization of parents and individuals working together for access to quality education services for isolated students" (ICPA, 2013).

An emic (insider) approach was adopted to capture thick and descriptive data from conversational interviews in the first study's data collection (Section 6.3.1 below), and to seek meaningful patterns from key participants (Gubrium and Holstein, 2001). Study one explored key issues about women and men's views on technology adoption. Key issues included the women's role in terms of technology, her role in the decision to use technology, and in what way the technology is helpful in the cattle production business; the women's views on technology management, and how the male graziers view the women's role when managing farming technology. Theoretical sampling of the interview transcripts (to generate and develop theoretical ideas) defined gaps in the data, which facilitated questions for the online survey, Study 2 of the research (see 6.3.2 below) (Gubrium and Holstein, 2001).

The online survey explored three main questions: Is the technology useful at personal or practical levels? What value does it afford the woman graziers; and will adopting farming technology improve business for the family units? In both studies, participants lived and/or worked on cattle producing properties. Ethics approval for the research was obtained through James Cook University procedures.

### 6.2. Queensland as the population

Queensland is the highest cattle producing state in Australia. The state covers approximately 1.7 million square kilometers of Australia (Queensland Government, 2013). In 2011, Queensland properties managed 12.6 million head of cattle, followed by New South Wales, 5.7 million, Victoria, 4 million, the Northern Territory, 2.2 million, South Australia, 1.3 million, Western Australia, 2.1 million and Tasmania 0.7 million (MLA, 2012a). Cattle are spread over the entire state, with clusters of small producers focused near the coast and the larger producers spread over inland Queensland (DAFF, 2013). As the largest cattle producing state in Australia, studying the technology adoption views in Queensland provides a basis for addressing the topic as a major cattle producing region of national importance.

### 6.3. Recruiting participants

#### 6.3.1. Study 1, conversational interviews

Interviewing has been used since ancient times, when rulers gathered information about peoples, age, and gender and where, they live (Gubrium and Holstein, 2001). In recent times, the conversational interview has been used to gain deeper and more meaningful data from the respondent (Lavrakas, n.d.). The approach allows for deviations from techniques such as standardized interviews where the respondent answers a list of predetermined questions (Roulston, 2008). In the conversational interview, the agenda for the interview is established interactively. A recursive process is used in which, the interviewer's questions build on responses to previous questions and responses from other participants (Burgess-Limerick and Burgess-Limerick, 1998). Interviewers are allowed to ask if respondents did not understand the question and they can provide unscripted feedback to clarify meaning or glean deeper more meaningful responses from participants (Gray, 2004; Gubrium and Holstein, 2001; Lavrakas, n.d.). Interviews are not recorded to ensure a natural conversation occurs. Conversational interviews do not require the participant to interpret the question exclusively, the researcher can provide any additional information needed to help the respondent map the specific terms in a question, or whenever they perceive the respondent requires assistance (Lavrakas, n.d.). The aim is to learn the respondent's reasons for doing or believing in something, clarifying meaning makes the technique more flexible and improves response accuracy (Kerlinger and Lee, 1992).

The conversational interview participants were recruited using quota sampling (Gray, 2004). The participants were non randomly selected from two mutually exclusive groups using purposive sampling (Gray, 2004; Saunders et al., 2009). The first group consisted of women aged between eighteen (18) and thirty five (35) years; the second group consisted of women aged approximately thirty six (36) years or older, and their associated male rural partners who were assumed to be near to the ages of the participants interviewed. Two mutually exclusive groups were used allowing the researcher to capture differences in technology use between generations, particularly generation X and generation Y (Australian Bureau of Statistics, 2012). To engage the participant, the researcher used subjective judgment to approach participants to join a conversation about 'Technology Adoption by Rural Women'. Informed consent was obtained, and a five to ten minute conversational interview followed.

A respondent's suitability for the survey was confirmed using filter questions. The first question asked what technology the participant had on their property. The participant's response confirmed (if they had technology) or rejected (if they did not have technology) their suitability for the study. A second filter question asked what the respondent produced confirming that the participant was within the scope of the study (that they lived and/or worked on cattle producing properties). All participants, except one, met the conditions of the study. The exception was a woman who bred Alpaca. The participant's suitability for the study was confirmed through her extensive use of technology with which she managed the Alpaca farm, and the remoteness of her property (in central Queensland). Participants were recruited from attendees of the Ag-Grow QMIX Field Day. The field day attracted the kind of people who we were interested in the topic; people concerned with modern technologies and living throughout Queensland.

Conversational interviews collected over three days at the Ag-Grow QMIX Field Day resulted in 60 sets of dialogue, which produced 17 pages of transcribed notes. Saturation was reached early in the interview process at around 20 interviews. To counteract saturation, the order of the questions was changed, which resulted in new and interesting responses. Initially each interview transcription was one to two pages in length. As transcription progressed similar or same information in each interview was not recorded, resulting in fewer pages of interview notes. Three interviews were not included due to insufficient data, reducing the total number of interviews to 57. Analysis of the dialogues proceeded by reading and re reading the field notes and recalling rich and meaningful elements of each conversation. The notes were transcribed in three phases: initially, directly after the conversation, later that evening, and again repeatedly during the first week after the field days until the researchers recall was exhausted. Summary themes were identified and then developed, from reading and then re reading the transcribed notes.

*6.3.2. Study 2, online survey*

The second sample for the online survey was gathered using cluster sampling beginning with the entire Queensland Isolated Children's and Parents' Association membership, which was divided into branches (Saunders et al., 2009). The sample incorporated 47 branches of Queensland's ICPA, which allowed for variations in the population to maximize representativeness (Everitt, 1993; Saunders et al., 2009). The ICPA group consists of parents and children who live on isolated properties, which are mostly cattle producing (A. Pegler, Queensland ICPA President, personal communication, 3 July 2013). ICPA members rely on technology channels for communication confirming their suitability for the survey, for example private radio, extended WIFI, mobile phone, UHF CB Channels, satellite technology and packet data (J. Little, Queensland ICPA Information & Communication Technology Advisor, personal communication, July 3, 2013). The members are likely to be both innovators and early adopters of new technology (Elliott et al., 2010; Reichardt et al., 2009).

An online survey was distributed to all Queensland ICPA members (approx 1200 participants) via the Queensland Secretary of the ICPA. A naturally occurring snowball sample ensued through the Queensland ICPA Secretary, who forwarded the survey invitation to three ICPA associated groups via Facebook (a further 600 potential participants) (Saunders et al., 2009). A second snowball sample occurred through telephone contact from the Mayor of the Barcoo Shire in Central Western Queensland, who received an invitation to the survey from the ICPA. The Mayor forwarded the survey invitation to 63 constituents of the Barcoo Shire. Although snowball sampling can produce immense problems in terms of bias, the Mayor of Barcoo and the Secretary of the ICPA identified the additional participants as being within the scope of the study (Saunders et al., 2009). That is, they lived and/or worked on cattle producing properties, reducing any chance of selection bias.

Participants in both studies were advised that technology should be defined as including personal computers, tablets, smart phones, accounting programs, cattle management programs, the internet, National Livestock Identification Systems (NLIS), remote cameras, remote weather stations, bore cameras, satellite technology, walk over scales, IVF technology, feedlot technology and other livestock management systems.

The second study consisted of a sixteen-question online survey, which asked participants about their experience with technology adoption and the role women play in the decision to adopt and manage technology, particularly from the homestead. The survey was open to women and men over the age of 18, who lived and/or worked on cattle producing properties. The majority of participants (86%) completed the survey in 5–15 min.

One hundred and seventy five surveys were returned. Only women responded to this survey, despite its open access. Forty surveys were incomplete, thus leaving 135 useable surveys for the study. Cattle producers (90%) were the highest respondents, supporting the scope of the study, next was sheep producers (22%), then croppers (17%) and finally cattle transporters and horse breeders (4%). Seventy-nine percent of the respondents were owners of properties ranging in size from less than 100 acres (3%) to more than 20,000 acres (59%), and 21% of respondents manage, lease or care take on a property. Sixteen percent of respondents were aged between 18 and 35; the remaining 84% were aged 36 years and older indicating high technology use among Generation X and Boomer (ABS, 2012) graziers, pinpointing an aging rural population.

The study sought to establish if technology was used on the property, then how useful was it at a personal or a practical level or both. It also aimed to investigate what value technology affords the woman grazier, and it sought to establish if adopting farming technology will improve business for the family unit. The findings of both studies are discussed below.

## 7. Results and discussion

*7.1. Is the technology useful at a personal or practical level*

Whilst the focus of this study was the adoption of rural technology, it became clear during analysis that Queensland graziers were primarily using the personal computer, the National Livestock Identification System (NLIS), smart phones and tablets, and walk over scales as rural business tools (see Table 1). The lack of diffusion of specific rural technology such as remote cameras, remote weather stations, bore cameras, and other livestock management systems, strongly supports the aim of this study, and ultimately, the question of who is driving rural technology use and adoption amongst the women and men who are cattle producers.

The study found that technology is useful through streamlining farming practices, increased productivity, and enabling choices in production practices. Table 1 details the use of administration oriented technology, confirming a personal level of technology use. At a practical level, livestock management technology such as NLIS, walk over scales and satellite imagery are well represented.

The responses to the study indicate that rural women may have unintentionally taken a formative step towards adopting rural technology by changing to computerized accounting systems, as suggested by their accountant. For some participants the lack of choice evoked feelings of doubt about if they could learn and complete computer based tasks. By contrast a majority of respondents turned feelings of apprehension into enjoyment and active adoption, as illustrated by the following respondent quotations:

> "*I was happy doing it manually, but our accountant told me I had to do it on the computer*"(*Shelly*)

> "*It was hard at the beginning … here I am a women that only went to grade ten, doing the accounting for the farm … my husband won't do the book work … it had to be done, so I did it*" (*Wendyb*)

Active adoption may explain women's proactive approach of using technology to explore new strategies for business growth. To

**Table 1**
Types of technology used on the property.

| Select the types of technology used on your property | | Frequency | Percent |
|---|---|---|---|
| Laptop | | 110 | 81.5 |
| NLIS (with or without wand accessory) | | 107 | 79.3 |
| Home PC | | 104 | 77.0 |
| Smart/mobile Phone | | 98 | 72.6 |
| Walk over scales | | 72 | 53.3 |
| Tablet | | 63 | 46.7 |
| Satellite imagery | | 41 | 30.4 |
| Satellite phone | | 22 | 16.3 |
| Remote cameras | | 18 | 13.3 |
| Other – | | 8 | 5.9 |
| GPS controlled steering (3) | GPS (not collars) (1) | Smart water (remote tank level indicator) (1) | |
| Embryo transfer (horses) (1) | GPS cropping (1) | | |
| Garmin GPS 2Way (1) | GPS property management (1) | | |
| Remote weather stations | | 6 | 4.4 |
| Bore or remote water trough cameras | | 6 | 4.4 |
| GPS collars | | 5 | 3.7 |
| IVF technology | | 3 | 2.2 |
| Feedlot technology | | 3 | 2.2 |

**Table 2**
Technology based tasks.

| Who uses technology on your property | Male[a] | | Female[b] | | Tech not used[c] | |
|---|---|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Online banking | 12 | 8.9 | 117 | **86.7** | 6 | 4.4 |
| GST/accounting | 15 | 11.2 | 117 | **86.6** | 3 | 2.2 |
| Checks business email | 36 | 27.1 | 99 | **72.9** | 0 | 0.0 |
| Checks personal email | 37 | 27.8 | 98 | **72.2** | 0 | 0.0 |
| Communicate with friends and neighbors | 37 | 27.7 | 96 | **70.8** | 2 | 1.5 |
| Social media | 16 | 12.2 | 87 | **64.1** | 32 | 23.7 |
| Searching the internet | 52 | 38.5 | 83 | **61.5** | 0 | 0.0 |
| NLIS management | 51 | 37.7 | 67 | **49.7** | 17 | 12.6 |
| Online news | 35 | 26.3 | 66 | **48.5** | 34 | 25.2 |
| Online weather | 70 | 51.9 | 64 | **47.5** | 1 | 0.6 |
| Cattle management software (iHerd, stockbook etc) | 27 | 20.0 | 32 | **23.7** | 76 | 56.3 |
| Managing feed supplies | 50 | 37.4 | 28 | **20.4** | 57 | 42.2 |
| Manage the business web page | 5 | 3.7 | 22 | **16.3** | 108 | 80.0 |
| Satellite technology | 30 | 22.3 | 17 | **12.5** | 88 | 65.2 |
| Remote cameras (wild animal control, anti theft) | 15 | 11.1 | 6 | **4.5** | 114 | 84.4 |
| GPS cropping systems | 21 | 15.2 | 4 | **3.3** | 110 | 81.5 |
| Check remote bore cameras | 6 | 4.1 | 4 | **3.3** | 125 | 92.6 |
| Remote weather stations | 4 | 3.0 | 4 | **3.0** | 127 | 94.0 |
| Manage IVF technology | 4 | 3.0 | 3 | **2.2** | 128 | 94.8 |
| GPS collars | 5 | 3.7 | 2 | **1.5** | 128 | 94.8 |
| Other (see below) | 5 | 3.7 | 3 | **2.2** | 127 | 94.0 |
| Community groups (1) | Gamin 2Way, satellite internet, TV (1) | | | | GPS – not collars (1) | |
| GPS – property management (1) | GPS weed monitoring (1) | | | | Online study (1) | |
| Property mapping (1) | Smart tank (1) | | | | | |

The bolded values show the percent of women who complete the listed technology based tasks on rural properties in Queensland.
[a] Males scores provided represent men using technology alone, as reported by females.
[b] Female scores provided represent females using technology alone, and sometimes assisting males.
[c] Tech not used represents males and females who do not use the listed technology.

comply with the National Livestock Identification System introduced in 1999 (MLA, 2012b), many women in rural partnerships (17% of women compared to 2% of men) opted to actively purchase new computer systems and other technology, such as walk over scales. Table 2 shows other tasks for which technology is used on rural properties. Indicating an above average level of personal use the results illustrate that most female respondents use their laptop and/or personal computers to check email, communicate with friends and neighbors, and use social media. However, the co-occurrence of the numbers of laptops and NLIS in the responses may indicate that practical use of technology is also highly important.

The high percentage of women and men completing NLIS management tasks and using cattle management software may point toward laptops being used in conjunction with NLIS technology outside of the homestead, such as in the cattle yards. Similarly, the rate of tablet computers and walk over scales may indicate that women at a higher rate than men are using technology more in the paddock (see Table 2).

The practical application is not only evident in the paddock. Women are clearly using technology much more than men in the homestead as well (Table 2). Women's exploration of new business strategies, which saw technology adopted because of compliance, transitioned into a useful tool for marketing. Several respondents commented that although they purchased the computer to do accounting work, they now use is to sell their cattle. One respondent uses technology to market her prize bulls, she gave stickers, fridge magnets, rulers and pens to each visitor at the field day. When asked if she used her computer to order the products online, she said "oh yes, I order them online every year. I enjoy it". Other respondents use the internet to manage the business website and social media pages, as commented below. Importantly, during the conversational interviews the husband's comments supported the participant responses.

"*I see great value in having technology, especially Gwen being able to display cattle online through the website*" (*Gwen's husband*)

"*Because we rely on Facebook to market our cattle, it's invaluable that Kate knows how to use it. I wouldn't know the first thing about Facebook and I am not inclined to learn, using Facebook to sell our cattle means less travel time and more time on the farm*" (*Kate's husband*)

Although only a few participants were using a business website (see Table 2), they all agreed increasing product exposure and profits was the main motivator to develop their technology skills.

### 7.2. What value does technology afford the woman grazier

Table 3 contains comments about the women's view of emerging value from technology use, as well as the men's view on the value of women (or specifically a female partner), using technology within their business. Value from technology is not limited to raising profits for grazing families. An important theme that

**Table 3**
Comments about emerging value from female and male participants during conversational interviews.

| |
|---|
| *"I think women gain a lot from having technology … it improves communication and reduces isolation, and many [women] like me, feel empowered to learn new things"(Rebecca). "She is very valuable to the business, if it wasn't for her we would not be able to take on technology, I wouldn't be able to learn it" (Rebecca's husband)* |
| *"… , learning how to manage the website gives me a sense of pride and achievement …" (Sonya). "I am very appreciative of her role in managing technology" (Sonya's husband)* |
| *"Gaining new skills gives me a sense of achievement"(Jo). "I value her contribution to the business" (Jo's partner)* |

emerged from the data was that the women viewed learning to use a computer or other technology as empowering, self fulfilling, and personally valuable, and many of the men were equally supportive of their technology adoption.

Participants who identified as working on a property also noted that technology management was falling to them as women employees, and that value came from status amongst employees.

> "*The farmer relies on me to use technology in the paddock, he often asks me to look things up on the internet … because I know how to use it [technology] he relies on me to run the NLIS scanner and the computer … it gives me an edge over the men by increasing my value on the property*"(*Rosemary*)

In addition to personal value, many participants also reported that technology is "easy to use and enjoyable" and stated that they "gained new skills" (Table 4). Personal value, ease of use, and usefulness, may be responsible for transforming information and experience with technology into empowerment, and in turn, into an equalized status amongst farming men and women (Bock, 2006).

Women in the survey stated that knowing how to use and manage technology made them more valuable in the rural partnership. Respondents believe that being tech savvy gave them a better standing in the community (Table 4) and as such a degree of control. In the context of information technology usage, "internal control (self-efficacy) is ones belief about his or her ability to perform a specific task using a computer" and "intrinsic value, is one's personal perceptions of pleasure and satisfaction from performing the behaviour" (Venkatesh, 2000). Confirming these beliefs provides a "causal flow to system specific ease of use" (Venkatesh and Davis, 1996). Presumably, intrinsic value will be the ultimate driver toward grazier families adopting more remote livestock farming systems.

A related theme that emerged amongst respondents was that technology gave women more control over the business. Eighty four percent of the online survey respondents said that they like to have control (Table 4). This response is supported by comments from the conversational interviews, which are illustrated below:

> "*The value comes from control over spending*" (*Naomi*)

> "*… it gives me some control over the business …*" (*Belinda*)

Rural women having control over the businesses finances through technology management is a source of empowerment, it shows their association with the financial side of the business, representing them as a valued cohort in the rural partnership. Therefore, technology adoption may become a platform for rural women to develop strategic roles in decisions on planning, production, and marketing.

The new technologies may not only bring changes to farming practices, but they also affect the farming lifestyle. When asked how having access to technology has changed the participants' lifestyle, the most common response was that technology was time saving (Table 5). Participants no longer had to travel to town to do the banking or pay the bills. This counter intuitive response ignores the point that trips to town most often have other positive effects, which may be lost. For example socializing with friends, and catching up on what is happening in the region, are perhaps lost opportunities for community connectedness. Foregoing trips to town may reduce this contact and lead to isolation (Deary et al., 1997). Despite this assumption, 76% of participants said having technology improved their communication with friends and neighbors, and 62% said having technology removed their feeling of isolation.

Table 5 reports that women gained value from being involved with production practices, even though they thought managing technology had increased their workload. Many women now worked outside during the day, and inside at night, nevertheless 80% said this suited them most of the time. Just under half of the respondents said that managing technology takes them away from outside duties that they would rather be doing. About the same number of participants identified that it enabled them to spend more time with the family, as well as the male in the partnership, which is conducive to farming families and lifestyle choices of rural partnerships (Hutson, 1987).

Several reoccurring themes appeared in the conversational interviews relating to time saving, money saving and increased communication. Respondents use technology to complete online banking, and communicate with buyers and suppliers by email, check the news and weather, complete research and manage the business website. They also use the computer to manage stock numbers, feed supplies, and complete GST and accounting duties. Many respondents also mentioned that time was saved by not having to drive, sometimes six hour round trips to town to complete banking, pay wages or do the shopping.

Michelle summed it up by saying:

> "*having technology available at the home allows me to spend more time in the paddock during the day and complete administration and marketing research during the night, if I didn't have that*

**Table 4**
How does technology help you, in terms of value?

| **How easy do you find it to use technology products?** | | |
|---|---|---|
| **Ease of use statement** | **Frequency** | **Percent** |
| I find it really easy to use | 66 | 48.9 |
| I struggled at the beginning, but now I find it easy to use | 66 | 48.9 |
| I simply can't get the hang of it | 3 | 2.2 |
| **Value statement** | | |
| I enjoy gaining new skills, so find technology personally valuable | 122 | 90.4 |
| I think knowing how to use and manage technology on the property makes women more valuable in the rural partnership | 110 | 81.5 |
| I like to have control over the accounting and/or cattle management programs | 113 | 83.7 |
| Being tech savvy gives me a better standing in the community | 69 | 51.1 |
| Using technology allows time for other jobs | 63 | 46.7 |

**Table 5**
How has technology changed your lifestyle?

| **Change statement** | **Frequency** | **Percent** |
|---|---|---|
| Access to the internet saves time because I no longer have to travel to town to pay bills | 107 | 79.3 |
| It has improved my communication with friends and neighbours | 103 | 76.3 |
| Managing the technology keeps me involved with production practices (e.g. NLIS management, stockbook, IVF programs) on the property | 99 | 73.3 |
| It has increased my workload because I work outside during the day and inside at night | 71 | 52.6 |
| Technology takes me away from outside duties that I would rather be doing | 64 | 47.4 |
| It allows me to spend more time with family | 37 | 27.4 |
| It allows the male in the partnership to spend more time with the family | 27 | 20.0 |
| I find technology a big waste of time, I would rather not have it | 9 | 6.7 |
| **Does working outside during the day and inside at night suit you?** | | |
| Most of the time | 57 | 80.3 |
| Never | 14 | 19.7 |

*option, I am not sure when the work would get done*". *She also said if they did not have access to technology at home, they "simply would not be able to afford to farm the way we do if we had to outsource the technology use*".

Clarice's husband reported the following view:

"*if she [Clarice] can use the computer to find the things that I need, it means that I don't have to abandon the farm to travel to town to find the products myself and then travel home again*".

Whilst women make a majority of the decisions to purchase technology for the homestead, men make the decisions when technology is to be used outside the homestead. However, as in most families farming or otherwise, high cost decisions are made together (see Table 6).

### 7.3. Will adopting farming technology improve business for the family unit

In terms of communication, many of the respondents were actively involved in social media and email communication (Table 2). The most common response was that technology allowed them to keep in touch with friends and neighbors, "especially when it's too busy to leave the property"*(Kelly)*. Others said that access to social media made them feel less isolated. This is evident in Table 5 and through participant comments such as:

"*Social media increased my contact with friends and family, it reduces the feeling of isolation, especially now the girls have left home*" (*SL*)

"*because it allows me to communicate with my friends, family and neighbours and it makes me feel less isolated*"(*Lucille*)

Women and men working separately on large cattle stations can lead to isolation between farming partners. Participants identified being able to work alongside their partner during the day and on the computer at night (Table 7), meant they were able to spend more time together and in turn, remove feelings of isolation from the men who usually work alone.

**Table 6**
Choice of adoption, purchase decision, and management responsibility.

| **Whose decision was it to bring technology onto the property?** | | |
|---|---|---|
| **Adoption statement** | **Frequency** | **Percent** |
| Both decided together | 102 | 75.6 |
| The female pastoralist | 23 | 17.0 |
| The male pastoralist | 3 | 2.2 |
| An external decision maker (e.g. the accountant) | 7 | 5.2 |
| **Who mainly makes purchase decisions for technology on your property** | | |
| **Purchase statement** | | |
| We both do, depending on the size of the purchase (i.e. if the purchase is a high cost purchase, we will discuss it together and then decide) | 122 | 90.4 |
| The female, if they are to be used for inside the homestead (e.g. a new computer, accounting, cattle management or education program etc) | 93 | 68.9 |
| The male, if the technology is to be used outside of the homestead (e.g. walk over scales, remote weather stations etc) | 77 | 57.0 |
| Other – ■ Depends on what it is (1) ■ Owner (3) | 6 | 4.4 |
| ■ Schooling – female (2) | | |

**Table 7**
How is technology useful on your property?

| Usefulness statement | Frequency | Percent |
|---|---|---|
| It has streamlined farming systems (e.g. walk over weighting, NLIS tracking) | 90 | 66.7 |
| Allows me to work outside during the day, and inside during the night | 85 | 63.0 |
| Technology has removed my feeling of isolation | 83 | 61.5 |
| It has helped to increase productivity | 82 | 60.7 |
| Saves time, allowing male and female property managers/owners to do other jobs | 61 | 45.2 |
| Because of technology, we are able to run the farm more efficiently using only family members | 60 | 44.4 |
| Technology takes the woman away from outside duties, which means we need to employ someone else | 26 | 19.3 |

However, it is worth noting that the reverse was not reciprocated, i.e. very few men gave up paddock work in the daytime to spend time in the homestead to help with chores thus removing feelings of isolation from the women. Participant comments included:

"*Being able to complete computer work at night means, I am available for other work during the day" (Kelly). Kelly's partner added, "Being able to continue to work with me during the day and on accounts at night makes her more valuable at home … Being able to work together in the paddock during the day means we get to spend more time together, making the work more enjoyable*"

Hannah said:

"*Mum left her job to take on the accounting duties on the farm, and dad can see the value in mum's duties. Allowing mum to work at home has made dad happier, which makes mum more valuable at home. Using the computer gets the work done quicker, which allows mum more time to spend with dad doing other jobs*"

Access to technology allows the rural community to remain in contact with each other, whether by social media, email or through technology allowing time for face to face contact making farming less isolating and more enjoyable. The exclusion of isolation is an important element of technologies contribution in the rural setting.

What became clear during the research is the limited amount of men who actually use technology on their own. Denise uses the computer to order marketing material; her husband said he "wouldn't know how to use the computer … I don't have the time to learn, I will leave it up to her, she [Denise] likes it anyway". Karen completes GST and accounting duties, her husband said, "I could never pick it up, working the computer is beyond me, so I am glad Karen knows how". Some male respondents (conversational interviews) said that they would not bother if it were up to them. Lucille uses the computer to process NLIS data, she said her husband can use technology, but he said, "I probably wouldn't bother if she [Lucille] didn't". Belinda's husband agrees, "I would not adopt technology if it wasn't for her [Belinda]" he sees the value in it [Belinda using technology] "because he can't do it and he wouldn't learn it". Tanya uses the computer for schooling for the children, paying the bills, and communication, she said, "Although he uses technology he can't do it without my help, I taught him how to use it, but if something goes wrong it is up to me to fix it".

At the same time that the men were admitting to being technology challenged, there was an overarching consensus that women knowing and managing technology makes them more

valuable to the family business. Almost all male respondents (conversational interviews) said that either they valued the women performing duties using technology or that they valued the input that technology had on the business, at the same time recognizing the women graziers'[2] role in using technology. Value for the business came primarily from saving money. Savings were achieved by not having to pay someone to do the accounting, by time saved through not having to travel to town, and by being able to research online, as well as use Facebook or the business website to sell cattle. Savings were also recognized using livestock management technologies such as walk over scales and NLIS management systems that fed directly into the computer, potentially eliminating employment of extra staff, and therefore saving on wages. When considering value attributed to women performing technology management duties, much of the men's belief about value, stemmed from their perception that they could not learn to use the technology, and from an assertion that men did not have time to learn to use the computer, supporting a shift towards women adopting and managing technology.

Overall, the online survey complimented the findings from the conversational interviews. The overarching significance is that women are adopting technology voluntarily and that they are finding value in more than increased profits and productivity. Women are empowered by emerging livestock management technology and are highly valued by their grazier partners.

## 8. Conclusion

Rural women use most components of technology three times more often than men. They view their role as valuable and important to the business and to the family; they view learning and managing current and emerging livestock management tools as empowering, self fulfilling, and personally valuable and the male graziers support these views.

Increases in demand for Australian beef products, a shortage of rural workers, and the need for efficient and intelligent ways to approach production see participants of this research turning to on farm technology and emerging livestock management systems to assist in boosting productivity. This study found that women are driving technology from the homestead for the paddock, highlighting a shift away from men as sole decision makers in the business, and more towards women playing a larger role in farming diversification and productive partnerships, potentially reversing rural women's invisibility in decision making and leadership positions (Alston and Wilkinson, 1998).

Adopting technology highlighted value to the business in terms of profit, and in terms of partnerships. The study found that rural women were empowered by technology and that their contribution to management via technology positively affected the bottom line. The men, who perceived that they were incapable or uninterested in adopting technology, agreed that rural women's interest in technology allowed them to gain substantial benefits from employing livestock management systems. In turn, increasing women's status, resulting in more equal partnerships. The responses from the interviews and the survey work reinforce one another with similar themes of dominance of the women's role emerging, and of multiple benefits being generated. The work extends the literature of Farmar-Bowers (2010), Alston (1995, 2004), Alston and Wilkinson (1998), Bock (2006), McKenzie (2013), Pini (2005) and Pannell and Vanclay (2011). There are limitations in this study in terms of not knowing the views of men who did not respond – possibly, they are less positive, less comfortable and less motivated to use technology.

This study recognizes the importance of rural women's use of and role in managing technology and the valuable skills and attributes that rural women bring to decision making in management and leadership. Change agents aiming to increase women's use of technology should acknowledge their role and embrace women as influential decision makers. The women's importance in this study may lead to a change of status amongst women and men graziers, and see a shift in the balance of power within rural partnerships. Women mastering technology use to increase productivity, and hence profits, may lead to women graziers' opinions becoming more valued and result in women taking control of management practices in the cattle producing businesses. In addition, women's involvement with technology may tip the balance when considering succession. The more technological the grazing property and business becomes, the more attractive it might be to a younger generation of graziers, which may be a solution to problems of succession, an area that requires further investigation.

For those who advocate on farm technology and remote livestock management systems, creating focus groups, obtaining the views of women graziers in how the technology functions, training for its use, and consideration of their existing time spent in front of a computer might be worth investigating thoroughly. There are also larger questions to be considered as PLF directs attention to productivity and profitability. These larger questions, as considered in this study, include continuing to monitor how PLF fits into the overall lives of both women and men in rural Australia.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jrurstud.2014.10.002.

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[2] Justification of the term Grazier woman – Changing Land Management: Adoption of New Practices by Rural Landholders Pannell and Vanclay (2011) discusses how to best describe the complicated work carried out by women on farms. It states that the term 'grazier's wife', was not a popular option and although little better, such terms as women farmers, women who farm, farm partners or members of the family farm business, were acceptable terms for use. The term farmer refers to someone who grows crops for human consumption, where as a grazier raises livestock (The Penguin English Dictionary, 2002). Although not ideal, this paper will use the terms woman/women grazier and grazier women interchangeably to describe women who own and/or work on cattle producing properties.

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