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“Women in Precision Agriculture: Advances, Challenges, and Aspirations for a Prosperous and Sustainable Future”

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Chapter 10

The impact of advances and challenges of bush internet connectivity for women in agriculture in Queensland, Australia

Online Version: Abstract

Adoption of agricultural technology such as remote cameras, remote weather stations, bore cameras, and other livestock management systems in the Queensland, Australian beef industry is inconsistent. Marketing of these technologies has previously been aimed solely at men as the decision makers in rural relationships. Past studies, which are traditionally linked to men's decision-making, indicate that there are several barriers to technology adoption, such as age, attitude, and education. Barriers may also be attributed to male beef producers' own perceptions that they do not know how to use technology or that they are not capable of using technology. This perception means technology-based decisions have been falling to rural women who are often identified as invisible farmers and therefore not recognized for their work. By contrast, as technology diffuses into rural settings, it is modifying gender divisions, and supporting women as they move from traditional separate roles in decision making to productive partnerships in farming families. This chapter encourages stakeholders to see women as both decision makers and community leaders. It highlights 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 in leadership.

Keywords: Women in Agriculture, technology adoption, decision making, leadership, management, ag-tech, livestock management systems, barriers to adoption, invisible farmers, connectivity, internet, well-being, succession, sustainable agriculture

Topics: Women in Ag, connectivity, access, reality and implication of available precision ag tools, remote use of internet (health, wellbeing), how tech can assist with succession, what does a sustainable future look like for AU women in ag

10.1 Biography

I am not afraid of storms, for I am learning to sail my ship (Aeschylus, 525 BC – 456BC)

I was a late academic bloomer, for as long as I remember I wanted to grow up and be a mum and that once I had reared my children, only then could I fulfill my own needs. I always knew I would ‘go back to school’ but I was not sure of what that looked like. I was very entrepreneurial. I always had a job, owned my own business, and with my husband was happy to build our empire. That was until our best friends died within a year of each other. Following the advice of Robert Kiyosaki (Kiyosaki, 2000) – if you don’t know what to do, take a year off and let your brain think without pressure – we took a year (2008/09) off to drive (with the kids) around Australia in a caravan. It was on return from this trip that I decided to enroll at the university, I was 39 years old.

I enrolled in a business degree because I was particularly interested in regional development and while our local university offered the pathway, it meant I had to take economics. Taking economics was very daunting, I had not done very well in high school, and it had been 20 years since I had looked at education, let alone the complex mathematical problems that came with economic modeling. As a first in family university student, I was determined to win the battle and show my children that education was cool. So through persistence, tears and with a very supportive husband I forged on. About half way into my degree, I realized that the economics degree I was taking was heading towards banking, which I was not interested in, so I changed my major to marketing. It was at this point I realized my passion for behavior change and social marketing and how the discipline can be used in regional development, and now ten years on, I wear a lovely regional development/social marketing hat and channel my energy towards creating change.

After doing well in my undergraduate, I started an honors degree where my love of research and agriculture combined to create change in rural, regional, and remote (RRR) Australia.

Not only were RRR families suffering from the effects of a digital divide and a paucity of internet connectivity (Correa & Pavez, 2016), women were struggling to keep their children's education at the same level as the city kids, and to break into a new world outside of motherhood, farmhand and homemaking. Another thing that really stood out was that rural digital technology, used readily in other agricultural industries, was not being used in the beef cattle industry, and that this was not solely due to a lack of access or connectivity issues. A situation worth studying, and so my first thesis was born.

My research allowed me to develop a reality among rural people through interpreting their meanings and understandings during conversational research and to share that reality with wider audiences. The respondents subjective reality allowed me to truly understand how a lack of internet connectivity affected RRR business, education, and personal wellbeing, contributing to hardship in RRR areas, and how this affected both women and men farmers. While the study was about women's adoption and use of technology, it is important to remember that for Australian farming families, many of the RRR women and men work as a team and they are not always cognizant of a gender divide. Therefore, the most important lesson from the research was to acknowledge the farming partnership and what effect the paucity of technology connectivity had on farming relationships through the lenses of women.

10.2 The beginning of behavior change for rural digital technology

For three days, I walked around a dusty agricultural field day interviewing Australian women and men (60 face-to-face interviews) about their technology use. It turns out that the men interviewed did not think that they could use technology and that the interviewed women who were using technology because they had to, were becoming experts. Three years later, I repeated my study, completing face-to-face interviews again to find that there were some changes in how rural digital technology was being used (more about this later).



Figure 1: Field Day Handbook

My study reignited previous work on women in agriculture in Australia and change started to happen. For example, one of the digital technology (water sensors) providers involved in my study changed their marketing strategy to focus on women as decision makers, significantly increasing their sales. Another example includes where men decided that technology may be easy to learn and use and as such, started using their smart phones to purchase spare parts, research markets and to check the weather. Rural digital technology in the study was identified as computers, laptops, smartphones, satellite phones, tablets, and walk over weighing systems, water sensor technology, livestock theft technology and the National Livestock Identification System (NLIS), apps and paddock to plate management systems (see some examples in Figure 2).

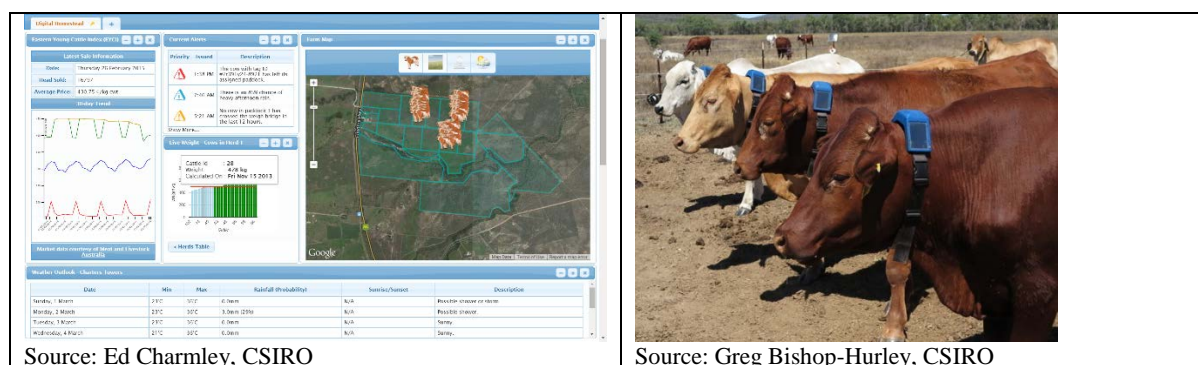




Figure 2: Examples of Rural Digital Technology (Usee, CSIRO)

10.3 A historical view of women's technology adoption

When I first started my PhD journey, I found that there were many articles about technology adoption by women entrepreneurs, women in construction, and the socio-economic status of women, as well as strategies for empowerment of women through adoption of technology in the rural home (3BL Blogs, 2014; Anugwom, 2011; Ndubisi, 2007; Verma, Verma, & Rani, 2013). However, very little research was available that identified factors that influenced women's decision to adopt rural digital technology – there is still a very large gap in the research here – and there is also very little historical evidence about women's motivations for adopting technology of any kind. This was intriguing and spurred me on, to continue to dig deeper.

By chance, I found an older article by Cowan (1979) that identified women “as bearers of children” (p. 52). Cowan (1979) highlighted that there are many inventions that are aimed at women, for example, the baby bottle, sterilizers, childbirth interventions and the baby carriage amongst other inventions such as the washing machine and vacuum cleaner, highlighting women's role as being in the household.



Figure 2: Advertising depicting women using technology for designed for women and for men ((Left) Bruce Floor Products 1948 (Right) Mowa -Matic Lawn Mower 1953)

This research trend – of women only being recognized for domestic duties – continued well into the 2000s (Alston & Wilkinson, 1998; Bryant & Pini, 2006; Little, 2009; Whatmore, 1991). Early advertising often depicted women doing both women’s and men’s duties, but rarely (if ever) the opposite, where men were doing women’s duties.

As I worked through the historical literature, it discussed male and female roles in purchase decisions. It highlighted males as the dominant purchasers of ‘brown goods’ i.e., goods that are for the home but not for house work, for example the stereogram, and females as the decision makers for purchases of ‘white goods’ i.e., goods that are used for housework for example the washing machine (Bose, Bereano, & Malloy, 1984). However, men rather than women were identified as the drivers of those purchase decisions. For the most part women made decisions in the household about food, small appliances and “purchases that reflect female activity in the home” (Bose et al., 1984, p. 61). Men were responsible for the remaining purchase decisions and typically, women were measured against the practices of men’s work and men’s lives as the norm (Little, 2009).

In this study, while men and women were identified as joint decision makers, this depended on the size of the purchase decision i.e. if it was high cost then the decision was made together in most cases (93.0%). However, decisions about inside and outside technology were still gender driven, for example 81.9% of women identified as the decision makers, if the decision was to be made about an inside (e.g. computer, accounting, cattle management or education program) purchase. When the purchase was for outside equipment (e.g. walk

over scales, remote weather stations) 76.9% of respondents agreed that it was the man's decision.

Very little historical writing about women's approach to the adoption of these or any other technology exists, reinforcing how invisible women farmers have been (and possibly still are). The term 'invisible farmer' is increasingly being used to define women who work in agriculture where their role is difficult to describe (Brandth, 2002). Women's position in farming is often tied to their marital contract, seen as the farmer's wife without independent status (Brandth, 2002, p. 184). The farm work that women do is often overlooked, unnoticed, and invisible to others (Brandth, 2002; Little, 1987; Whatmore, 1991), hence the term 'invisible farmer'. To contrast this, amongst others in Australia, work is being completed by Museums Victoria as part of the Invisible Farmer Project funded by an Australian Research Council Grant (Museums Victoria, 2017), which aims to recognize women's contribution to agriculture.

10.4 The Gender Divide

The gender division in agriculture highlighted a social inequality that is not only based on gender (Little, 2009), but also based on gender relations, capital resources (women marry into the family so men own the capital) and decision making (Bock, 2006). The results from my survey indicated that 38% of women identified as "invisible farmers" (Brandth, 2002; Bryant & Pini, 2006) labelling themselves as wives, spouses, or daughters of the property. This gender division brings a focus to the disadvantages of rural residency (suffering problems of remoteness and poor services), and a lack of social and economic equality for women (Little, 2009; Penley, 1991).

There is also a link between gender and technology where men using agricultural technology reinforces patriarchal ideologies that ultimately marginalize women to exclude them from both farming and decisions about farming (Bryant & Pini, 2006; Saugeres, 2002). This link is challenged by this research. These marginalization's were justified by the proposition that women's changing role on-farm may challenge men's masculinity as men associate working with machinery with leadership (Brandth, 1995, 2006). Previously, by downplaying the gender difference, the essential role of women in economic profitability of and therefore viability of the farm, could essentially be ignored (Little, 2009). However, according to farming women in Australia, men are not challenged by women's adoption of technology.

The results from this study showed that more women reported using typically male-oriented rural technology. For example, 44.5% of women reported using NLIS management systems compared to men (31%), and there was an increase in women using technology such as satellite mapping, remote cameras, In Vitro Fertilization (IVF), and GPS property management tools (Hay, 2018). When asked how valuable women working with technology was to the farming business, 94.7% of men responded that it was an important contribution. They also commented that women keeping up with technology allows better decision making, and that their contribution makes them a valuable part of the team.

While women worked to contribute to agricultural production, they also combine off-farm, non-farm employment or other revenue streams (Blad, 2012; Eikeland & Lie, 1999). This was not seen as a threat to masculinity but encouraged as a contribution to diversifying income. Over time, farming women have become more involved in decision making, which has led to women's role in farming being recognized as valuable (Alston & Wilkinson, 1998; Claridge, 1998; Farmar-Bowers, 2010; Gasson & Winter, 1992; Pannell & Vanclay, 2011; Rickson & Daniels, 1999; Umrani & Ghadially, 2003).

10.5 Australian Women in Agriculture

Women involved in Australian beef production suggest that there is very little division of gender within the industry. Rural women see women and men as being on a level playing field...“It's about being together, men and women on farms don't see themselves as having a gender based role, but as the job getting done by whomever is available to do it” (Interview number 8).



Figure 3: Australian Women in Agriculture

These views are being recognised in recent research, for example Beach (2013) states: “while the discourses of the family farm and masculinization do occur...neither one is the primary discourse expressed by farmers” (p. 225) supporting Australian rural women’s views.

However, the recognition is not yet far reaching.

Australian women surveyed in the study worked on or owned properties that are between 10,000 and 20,000 acres in size (76%), they primarily worked cattle (96.5%) and the majority had children either at home or at boarding school (which means they came home part time). Australian women in agriculture have not always worked in the industry. The majority of women in the survey were previously teachers, worked in education, administration, or nursing, closely followed by banking, finance, or commerce. They used technology both within the home and in the paddock (laptop/tablet, National Livestock Identification System (NLIS), remote cameras, remote weather stations, walk over scales, remote water cameras and sensors and In Vitro Fertilization (IVF) technology). Women participate in activities such as online banking (85.9%), accounting (85.0%), business (72.8%) and personal communication (emails 72.1%), social media (62.7%) and communicating with friends and neighbors (70.7%). Social media was used (2016) in many cases to sell cattle and other farm products (machinery, fencing etc.) and to run their online businesses from their remote cattle stations.

While women are embracing technology, it was not always their first choice; for many the use of technology fell to them because they worked primarily from the house. However, as technology becomes more mobile, others on the farm are becoming users as well. In the first round (2013) of data collection, none of the men in the farming family were using technology. By the second round of data collection, three years later (2016), ‘others’ on the farm were using some sort of technology; this in turn was reducing some of the technology user burden from the farming women. The women identified the new users as their husbands (the highest technology users, 22% more than the first year), followed by both male and female workers and children. When making decisions about technology purchased for the farm, the results show that men and women were making them together in most cases (73.9%) in the first round of study. By the second round, women were making more decisions about technology on their own (43.7%), indicating a shift towards women making decisions on farm.

10.6 Technology and Well-being

Australian women in the study highlighted that technology was also helping to reduce isolation (75.4%), one woman respondent quoted “Having access to information decreases social isolation, access to family and friends via Skype is good for my mental health” (Hay, 2018, p. 245). Australia has a high rate of suicide in RRR areas (Roy, Tremblay, Robertson, & Houle, 2017). The mental health and well-being of people in rural areas of Queensland has suffered from the effects of prolonged drought and other external factors (such as the interruption to live meat export trade (2011), and more recently (2019) extensive floods and large-scale bushfires in 2020). For example, live meat export from Australia worth \$1.4 billion was suspended from June 2011 for 6 months due to cases of animal cruelty being exposed in Indonesian abattoirs, halting trade and devastating farmers and regional economies (McDonald, Henderson, & Middleton, 2011; Wagstaff, 2016). The consequences from flooding and bushfires have not been fully quantified at the time of writing.

Technology has extended resources and access to services, as well it has increased training opportunities for health workers, which has a positive effect on mental health and well-being (Allan, 2010). Women who can access health and well-being programs online can use the information to help the men in their family (Powell et al., 2012), whether they be husbands, fathers, sons or workers, to access well-being services. Women’s access to male family members and workers has been identified as an entry point for male related mental health and may well be the key to increased well-being, especially in men, “Women are the key to accessing men because women are crucial to keeping families together” (Congues, 2014). Men’s responses agree highlighting that women’s role in technology helps to speed things up, leaving more time to do things as a family – highlighting that – “people really have no idea how important this [having more time for family] is to people in rural Australia” (Hay, 2018, p. 161). In addition, access to technology means that workers, including adult children, are happier on farming properties (79.4%). However, this happiness does not totally translate to women’s mental health.

While mental health was mostly self-rated as positive, 43.2% of women self-rated their mental health as moderate, 6% self-rated it as poor or extremely poor and 29.6% self-rated their mental health as excellent. The moderate scores may be due to some women not wanting to be responsible for using technology (47.4%), as working with technology ignores competing priorities that ask women to decide between other duties that they perform (such

as off farm work) and technology-based duties (most often delegated to night work). Women are sometimes frustrated being responsible for using technology and then getting the blame when something goes wrong, adding to their frustration. While women reported that working off-farm had little effect on their emotional health, they indicated that working off-farm may not be satisfying as they would rather be working on farm. Schirmer et al. (2016), Chang and Mishra (2008), McCoy and Filson (1996) and Van den Broeck and Maertens (2017) support this comment as the researchers found that women who work off-farm may be less satisfied than those who only work on-farm or do not work at all.

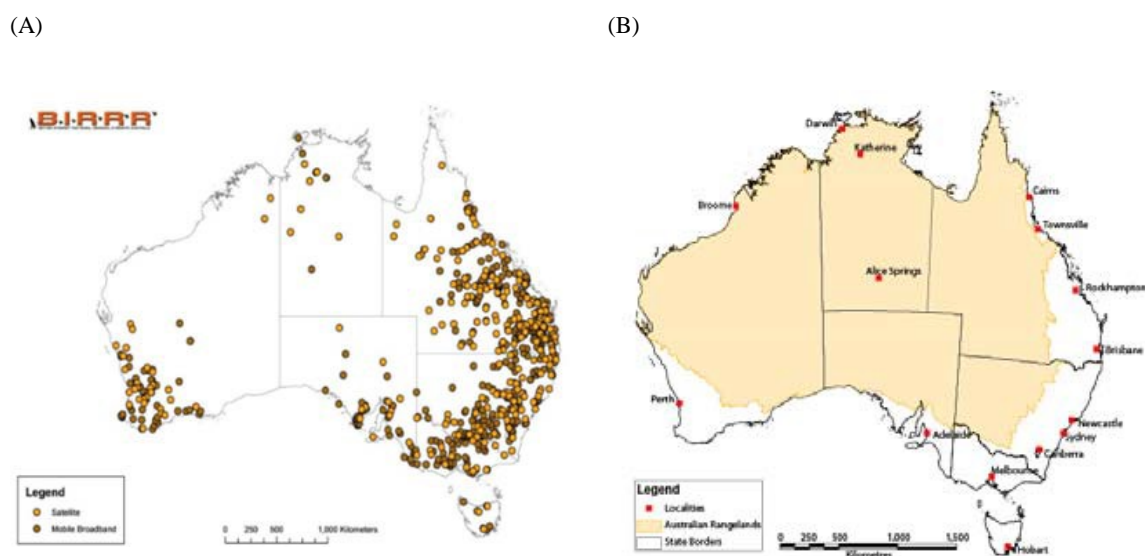
The majority of female and male participants agreed that having access to the internet increases their quality of life/well-being and that by having access to the internet, they feel more equal to people in more internet accessible areas. Participants agreed that completing computer-based work at night allowed the women to work alongside their partners during the day, which made their partner happier (less suicidal) and as such, made their life happier. They also agreed that being able to work alongside others during the day contributed to their sense of well-being. Female respondents agreed that partners, children, and workers mental health was positively affected by the woman working outside during the day and on the computer at other times.

10.7 Bush Internet challenges and advances

Australia is a big country; it covers approximately 7.692 million square kilometers (Dept. of Environment and Energy, 2005). Around 81% of this is broadly defined as encompassing rural, regional and remote areas of Australia. Rangelands are characterized by “eucalypt savanna and native grasslands, small areas of cleared land and scattered settlements, and rivers and wetlands that sustain ecosystems” (Dept. of Environment and Energy, 2005, p. 1). The rangelands are the home of Australian beef cattle production, where the industry produces around 27 million head of cattle to the value of \$17.87 billion (2014/15) (Meat and Livestock Australia, 2016a). Agricultural products from Australia are highly regarded, as such, the beef industry looks to Information Communication Technology (ICT) to help boost production to meet projected global food demand goals (Linehan et al., 2012).

ICTs have the potential to transform how people live in rural, regional, and remote areas. New internet and mobile phone technology is allowing producers to keep in contact, not only with friends and relatives, but also with markets, suppliers, telehealth services, weather, flood and fire services and banking as well as remote education. However, access to networks in

Australian Rangelands is challenging (BIRRR, 2016a; Curtin, 2001). ICT connectivity across the Rangelands is limited. For example, Figure 5 demonstrates a lack of overlap between the Australian rangelands and internet responsiveness to a national survey of internet usage (BIRRR, 2016a). In many sparsely populated pastoral regions, download speeds can be as low as 0.7 Mbps (BIRRR Regional Internet Access Survey Results, 2016). Expensive and unattainable access to either mobile or internet connectivity is adding to the digital divide currently experienced by those on the Rangelands (Curtin, 2001). My research supports a small group of cattle producing women who are using social marketing to advocate for change.



Note: not all addresses could be mapped, and (B) location of Australia

Figure 5: (A) Responses mapped from the Better Internet for Rural Regional and Remote Australia (BIRRR) Regional Internet Access Survey showing access to internet in Australia (Kristy Sparrow, BIRRR, 2016a). (B) Map of Australian Rangelands, Department of Agriculture and the Environment

As my journey progressed, my work in technology adoption by women in agriculture led me to a volunteer group of Australian cattle grazing women who had started an advocacy group aimed at #fixingbushinternet in RRR Australia. The team employs social marketing practices and advocacy (Novelli, 2011) and uses community connectedness through their social networks (Lefebvre, 2013) to focus on fixing bush internet and putting an end to the data drought experienced by RRR communities in Australia. I became their data analyst and presented their survey data to a level that was recognized by Government (BIRRR, 2017). We as a team wrote submissions to Parliamentary Enquiries to advocate for better and fairer internet in the bush. We lobbied government, relevant industry bodies, and

telecommunications providers to highlight shortfalls in service provision. These shortfalls would have previously gone unnoticed. The group, through widespread surveys and advocacy, has successfully achieved unmetered access to specific distance education sites on Telstra mobile broadband, dedicated education ports on nbn^{TM1} Sky muster, a dedicated RRR contact team with nbnTM, and increased data plans on nbnTM, each of these, decreasing the digital divide in RRR areas of Australia.

10.8 Women's motives, actions and intentions for technology use and management

Women are using technology more than men are and when men are using technology it has usually been purchased, set up, and maintained by women. Specifically, technology used by women relates to both management practices and social connection. Both management practices and social connection are leading to less isolation in terms of having better access to business management and communication tools. Women are motivated to use technology to research and improve production, manage accounting practices, and to improve communication to create opportunity for and within their family business.

Interestingly, while men are using technology more in 2016 than in 2013, they are using the technology-based tools (nearly always installed by women) more practically for example by checking market pricing, weather, remote sensing technology and remote cameras, saving time by streamlining farming systems and increasing productivity rather than seeking decision making information.

Women and men are making decisions about technology together, whereas in the past this was reported as being the men's role. Although some women are frustrated by having extra duties involving technology, they are motivated to continue to manage technology.

Significantly, women are gaining valuable skills over time and they feel a sense of achievement, empowerment, and self-worth by managing technology. Importantly, having technology on the property has improved management practices, decision making, record-keeping and planning, and it has given access to information that women would otherwise not be able to gather whilst situated at their property.

¹ NBN Co Limited is an Australian government-owned corporation tasked to design, build, and operate Australia's National Broadband Network as a monopoly wholesale broadband provider.

Technology can be intrusive. However, it can also save time, money and allow for broader communication with peers, industry, and customers, increasing competitiveness in their industry. The study supports earlier research that reduced isolation and the depletion of the tyranny of distance (Blainey, 1983) are encouraging women to adopt technology in rural, regional, and remote areas of Australia. Therefore, a strong focus on increasing internet connectivity by government and other stakeholders is required.

The Technology Acceptance Model (TAM) (Davis, 1989) is supported by this study as a practical application that suits the personality styles of women producers. Namely, that it uses both perceived ease of use and perceived usefulness to determine a person's attitude towards adoption. Adoption is determined by each woman's individual environment, which will be affected by other factors for example technological, socio-economic, agro-economic, institutional, informational, and behavioral factors, and by producer's perceptions (Tey & Brindal, 2012). Producer decisions about adoption will be driven by the problem at hand (Öhlmer et al., 1998), by cognitive and normative influences (Bearden & Etzel, 1982; Miller et al., 2011) as well as by family and individual motivation, suitability and opportunities available (Farmar-Bowers, 2010), and by a producers' level of adaptive capacity (Berry et al., 2011a). However, while a woman's adaptive capacity can give them the ability to change and take advantages of opportunities or cope with stress, ongoing challenges with internet connection for rural, regional, and remote Australia, still presents as the biggest barrier to technology adoption.

Technology that is more portable, such as laptops, smart phones, and tablets are being used on farm, demonstrating that technology is being used outside of the homestead. Women are using both practical and communication technology but are moving away from things like searching on the internet, towards using social media to run off-farm businesses or to sell their cattle. While men are using technology more, women are still responsible for purchasing, programming, and teaching male producers how to use the selected technology. Having access to the internet is increasing quality of life for both women and men as well as children and workers. While some women are still somewhat reluctant to take on technology on-farm, others feel empowered and valued in their work. As technology is diffusing into rural settings, it is modifying gender divisions, and supporting women as they move from traditional separate roles in decision making to productive partnerships in farming families, encouraging stakeholders to see women as both decision makers and community leaders.

10.9 Contribution to the topic

This chapter contributes to existing knowledge about diffusion of rural digital technology into beef producing families. It informs stakeholders, government, policy makers and other stakeholders including the media, and communications and technology service providers about factors that influence technology adoption and women's key role in adoption decisions, and thus how to enable rural women to support their farming business and their lifestyle as well as increase productivity in the beef industry. It highlights women's role in decision making in beef production practices, identifying how digital technology affects the beef production business, personal career path and family aspirations from a women's perspective.

The work recognizes the importance of the women's role in decision making in beef production practices, increasing self-worth and importance. Recognition of women as producers may help to shift their roles from representatives of the beef industry to participants in decision making about the beef industry, allowing rural women to build networks and contribute to the beef producing community. However, the implications for the research reach beyond the beef producing community to benefit the wider community by providing food security, jobs, tourism opportunities, and a future for beef producer's children.

10.10 Conclusion

I am immensely proud of my work over the past nine years in technology adoption by women in agriculture. It has led me on a pathway that was previously unknown to me. I have been able to apply the knowledge I have gained to other areas including best management practice in water quality on the Great Barrier Reef, Business Coaching for rural producers, widening participation in education, advocacy groups, behavior change and readability and communications. I have produced 34 publications (academic and industry) over the past five years and I have recently been elected as a Board Member for the Queensland Rural Regional and Remote Women's network, which aims to connect, develop, and inspire RRR women. My research has allowed me to travel to present at many reputable national and international conferences, even those outside of my comfort zone. As a social scientist, I recently presented findings from the behavior change project that aims to understand farmers' best management nutrient practices to distinguished world renowned expert scientists (you know the real ones), which was daunting, but I did it! I bring with me my own thoughts and biases

and I respect those of others. As I travel through these next few years as an early career researcher, I hope to continue to develop my niche, my expertise and to enjoy the behavior change of a nation as it traverses the digital divide and all that technology adoption can bring with it.

Bio

Dr Rachel Hay is a Social Scientist and early career researcher teaching into Marketing for the College of Business Law and Governance at James Cook University, Townsville, Australia. Rachel's research centres on trans-disciplinary approaches to sustained behaviour change in social marketing and environmental protection interventions. Projects changing behaviour to reduce sediment and nutrient run-off in sugar cane farming and grazing, the Digital Homestead Project, Instant Feedback Assessment Techniques, Business Coaching, FIFO and the Creative Industries. Rachel's passion is to support rural, regional and remote regions to connect and stay connected through reliable, sustained and affordable internet connectivity. Should this occur, then sustained regional development will follow.



Rachel Hay 2020 Cropped.jpg

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