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Information provision and retrieval in the farming industry in Western Australia

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Information Provision and Retrieval in the Farming Industry in Western Australia

A dissertation submitted in fulfilment of the requirements for the degree of

Doctor of Information Technology

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ABSTRACT

Agricultural information dissemination to farmers has been studied extensively. However, farmers preferred methods of delivery has not been investigated thoroughly within a Western Australia (WA) context.

Availability of different information delivery channels have led to the overwhelming and overlapping of information available to farmers. As a consequence, the type of information required by WA farmers should be considered as knowing information needs could allow farmers to access relevant, concise and timely agricultural information.

To answer the research questions, a survey was designed, using Likert-scale, close ended and open ended questions techniques, enabling qualitative and quantitative data analysis. The study‘s findings are relevant to agricultural information providers, government and public agencies, and other researchers who work in the agricultural and farming industries in Western Australia, and Australia.

DECLARATION

I certify that this thesis does not, to the best of my knowledge and belief:

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ACRONYMS

AAAC	Australian Association of Agricultural Consultants
ABS	Australian Bureau of Statistics
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACMA	Australian Communications and Media Authority
AgrIDS	Agricultural Information Dissemination System
AIA	Australian Institute of Agricultural Science and Technology
AIAST	Institute of Agricultural Science and Technology
BYG	Bridge Yield Gap
CIFF	Customised Information Flow Framework
CSIRO	Commonwealth Scientific & Industrial Research Organization
DAFWA	Department of Agriculture and Food of Western Australia
DAWA	Department of Agriculture, Western Australia
GRDC	Grains Research and Development Corporation
GGA	Grower Group Alliance
FAO	Food and Agriculture Organisation
FPP	funder-purchaser-provider model
FDSF	Farmer Decision Support Framework
HYP	high yield packages
ICT	Information and communication technology
PaDIS	Pest and Disease Information Services
ITP	Information Technology Professional
NBN	National Broadband Network (NBN)
NFF	National Farmers Federation
TV	Television
WA	Western Australia
WANTFA	Western Australian No-Tillage Farmers Association

CHAPTER 1 INTRODUCTION

The amount of information available to the modern farmer is enormous and, for farmers, this information means potential empowerment as it is vital in decision-making processes. Information may lead to new knowledge, and better decision-making and communication (Kalusopa, 2005). According to Armstrong and Diepeveen (2008), a farmer's ability to make informed decisions is limited by the adequate provision of information. This view is supported by Umber (2006) who claimed that for growers to use the information available to them effectively, that information needs to be available in a format that can be incorporated into growers' decision-making processes. The Food and Agriculture Organisation (FAO) proposal (2004) which asserted that, in the domain of agriculture and rural development, new projects are often developed without any consideration of the existing information services. This view was shared by Pesce, Maru, Salokhe, and Keizer (2009, p. 150) stating that "the demand for quality information services on 'who is doing what' and 'who is operating in which areas' is high". The authors added that the management of agricultural information by many different information services with independent databases has often led to overlapping information coverage and can only, therefore, offer partial answers.

Dercon (2009) and Gollin (2010) suggested that the agriculture sector is essential for economic growth and there is evidence to suggest that in various countries the desire exists to improve the dissemination of agricultural information through the development of information systems. For example, in India, Reddy and Ankaiah (2005) have developed an information framework—the Agricultural Information Dissemination System (AgrIDS) framework. This framework was developed to disseminate agricultural information to farming communities in India.

Much research is needed to improve agricultural information dissemination because adopting new technologies and practice is dependent on social, demographic, political, technological and economic factors (Dorfman, 1996; Isgin, Bilgic, Lynn Forster & Batte, 2008). Armstrong and Diepeveen (2008, p. 2) specifically suggest that research "is needed to establish the role that new technologies can have in the farmer's decision making process". This thesis project attempts to begin making in-

roads into this vital area of research by investigating Western Australian farmers' perceptions and use of various information distribution channels within their industry.

1.1 Background

1.1.1 The Evolving Modern Information Environment

The way information is gathered and accessed has changed with the rapid development of information and communication technology (ICT), and the increase in ownership of computers and other accessories. Consequently, the reliance and use of facilities such as traditional paper-based libraries and telecentres to access educational information has been declining. In rural Western Australia there are approximately 100 Telecentre Networks which are owned and managed by the community throughout Western Australia (WA). The program started in 1991 supported by the Department of Local Government and Regional Development and Lands, and this support is essential to the success of the network. Telecentres provide computers with access to the Internet, printers, photocopiers, faxes, scanners, TVs and videos and videoconferencing facilities. According the ICT Regulation Toolkit (2012, Para. 4), the Telecentres act as "information providers, education and training deliverers".

The Australian Bureau of Statistics (ABS) (2009) found that in 2007–2008, an average of 66% of farms in Australia were using the Internet for their business operations, ranging from 59% to 74% across states and territories, with 73% of WA farms using the Internet for business purposes. This thesis will report on research into the dissemination of agricultural information to WA farmers, and will examine the issues which are determining the effectiveness of the provision of agricultural information to these stakeholders by examining farmers perceptions and use of agricultural information and information channels. The thesis will begin by describing the background to the study and its significance, and then state the research questions. Next, a review of literature will set the scene for an exploration of the research questions. This will be followed by a description of the research methods employed in the study and details of the research activities undertaken. Subsequent chapters present and discuss the analysis of the research results. Finally, a

discussion of how the research findings have contributed to the answering of the research questions will be provided.

1.1.2 Agriculture in Western Australia

WA covers a land area of 2,529.880 hectares, which makes it the largest state in Australia. However, it houses less than 10% of the Australian population. The ~~a~~administration of the urban and regional areas of this large and diverse state is divided amongst 142 local government authorities; nine development commissions; and a number of State and Australian government departments and organisations" (ABS, 2011a, para. 1). There are 10,889 farms in WA employing 29,200 people. This number includes employees in (traditional) agriculture, as well as fisheries and forestry, and consists of 15,347 farmers, 348 registered agricultural consultants and 420 agricultural scientists.

According to the ABS (2011a), in the 2008–2009 financial year the gross value of the top three (crop) agricultural commodities produced was $3.8 billion, consisting of:

- 8,274,000 tonnes of Wheat, worth a total of $2.5 billion;
- 3,007,000 tonnes of Barley, worth a total of $687 million; and
- 1,175,000 tonnes of Canola, worth a total of $649 million.

In 2009–2010 the gross value of all WA agricultural production was $6.4 billion. The export value of such commodities is massive, with 95% of WA's grain, 77% of its livestock, and 17% of its horticulture products exported to other countries (National Farming Federation[NFF], 2011a & 2012; ABS, 2007 & 2010b). In comparison with other states in Australia, the WA beef industry is relatively small with a comparative value of $487 million recorded for 2007 and 2008. The local domestic market uses 65% of beef production while 35% is exported (Warwick Yates and Associates, 2009).

The total value of agricultural exports in Australia in 2008–2009 was $32.1 billion, representing 11% of total commodity exports (National Farmer Federation, 2011a). The major export markets for Australia's agricultural products are listed in Table 4 below.

Table 1.1 Major export markets for Australia's agricultural products (National Farmers Federation, 2011)

	Destination	% of export
1	ASEAN (Association of Southeast Asian Nations)	19
2	Japan	16
3	Other Asian countries	13
4	Middle East	11
5	United States	10
6	China	10
7	European Union	8
8	Other	13

1.1.3 Overview of agricultural information and services

In the last decade, agricultural information dissemination has been influenced by many factors, such as rapid changes in technology, the influence of policy makers, and the government's role in funding agricultural extension. Furthermore, farming has become more specialised, with sophisticated requirements by farmers for technical, management and marketing information (Marsh & Pannell, 2000). According to Khalil, Hassan, Ismail, Suandi, and Silong (2008, P.1) An ~~-a~~gricultural extension worker in this sense serves as an administrative leader and coordinator for formulating, developing, implementing and evaluating agricultural extension programmes as well as developing farmers in managing resources in the rural areas".

It has been recognised by the Grains Research and Development Corporation (GRDC) annual report 2009–2010 that ~~-n~~information needs and preferred delivery mechanisms differ according to production region, enterprise mix and individual circumstances" (Grains Research and Development Corporation 2010, p. 39). The following sections will outline some of these differences as well as recent changes to agricultural information demand and delivery in WA which will provide a back-drop for the study presented in this thesis.

Public Sector versus Private Sector

Traditionally, agricultural extension has been characterised by the public sector, with the state Department of Agriculture as the major provider of agricultural extension

services. However, gradual policy changes by the WA State government in the 1990‘s caused the Department of Agriculture to review and restructure the services they provide. Now, a large proportion of extension is undertaken by private sector providers. Marsh and Pannell (2000, p. iv) stated that —these changes are continuing and have presented the agricultural community with certain challenges and problems”. In the last ten to fifteen years these changes have resulted in substantial state government funding reductions, which in turn forced departments of agriculture in most states to review the services they provide. Watson (1996), and Woodgate and Love (2012) have found that the number of extension services has declined, whereas private consultants have increased in numbers throughout Australia. However, the public agencies are still providers of extension services, despite the cutback in the services they provide. Moreover, in some cases, public agencies are moving towards the coordination of extension service providers. Furthermore, Marsh and Pannell (1998a, p. 2) reported that ‗state agencies are still generators of information through their research programs, and so have responsibilities for ensuring that dissemination of this information occurs, even if it is not done by them”.

According to Nabben, Warburton and van Moort (2006, para. 4), in 1996 the WA state agricultural sector ‗was restructured to provide a more accountable, participatory and business approach focused on the market and customers”. Thus, the Funder-Purchaser-Provider (FPP) model was adopted. The theory of this model is based on the distinction between the purchaser and provider of services. FPP is seen by some campaigners as critical in improving accountability because it permits activity-based accounting. The implementation of this system requires agencies to clearly separate themselves from the role of a purchaser of services to the role of provider (Marsh & Pannell, 1998b). It also allows ‗information‘ to be conceptualised as a commodity to which a monetary value can be attributed. As a result, the FPP model enables outsourcing: agencies are now able to employ staff to deliver required extension or even research (Marsh & Pannell, 1998b).

As explained by Marsh and Pannell (1998b, p. 4), ‗a real benefit associated with outsourcing is that it attracts private-sector funds into areas that were previously the

responsibility of the public sector". The FPP model implementation, as well as the outsourcing of activities in the public sector, have resulted in the use of private consultants to deliver government-funded research. Some trial work, which was the responsibility of the public sector, is now done by the private sector. The Research and Development Corporation, for example, are inviting private sector organisations to apply for research funds. Consequently, these changes have been taken advantage of by the private sector, which is now taking a superior role in agricultural research and extension, as well as making a bigger contribution to policies and the ability to priorities research (Marsh & Pannell, 1998b). For example: in the mid 1990's after much debate regarding the moving of crop breeding to a commercial industry base rather than a government base, the Council of Grain Grower Organizations Ltd (COGGO) was formed in 1997 representing 10 grower organisations in WA. Growers invested voluntarily under the management of COGGO, contributing 0.5% of their crop production to crop breeding and associated research and development. This investment by growers has had its influence over crop breeding research in WA (Council of Grain Grower Organizations, 2013) over and above public sector research.

Changes to Agricultural Extension

There have also been changes in the state public agencies. As a result, the Research and Development Corporations (RDCs) are now taking a more practical role in extension. The charter for the RDCs, as listed in *The Primary Industries and Energy Research and Development Act, 1989*, includes a role "to facilitate the dissemination, adoption and commercialisation of the results of research and development" (Marsh & Pannell, 1998a, p. 2; Cary, 1998). Previously only small amounts of resources were allocated to technology transfer, however, since the 1990s it has been funded as part of the research process (Cary, 1998). In May 1990 the federal government launched the Cooperative Research Centre (CRC) program. CRCs act under a mutual scheme bringing together researchers from universities, the public sector and business. There are currently 15 CRCs related to agriculture research in rural areas, aiming to encourage effective networking between public institutions and the agriculture industry (Marsh & Pannell, 1998a).

Marsh and Pannell (2000) have raised concerns regarding accessibility, accountability and responsibilities within the public and the private sectors, and the competition between them. According to the authors private sector researchers are less willing to share information where intellectual property rights have been implemented. There is concern over the loss of expertise in public sector extension services especially in research, and the ultimate availability of information for the WA farming industry. Government policies that encourage the privatisation of research and extension raises a serious issue since, ―once supply is placed in the hands of those with primarily commercial objectives, the scope for ongoing direct political intervention is substantially reduced" (Carney, 1995, p. 524). The impact of the shifts in who is responsible for information generation and dissemination will be investigated in terms of changes in WA farmers' information behaviour between 2001 and 2011.

Extension can bring positive information outcomes through improved networking and information flow within the agricultural industry, organisations and farming communities. Extension is an important activity across Australia in both the public and private sector; however, the delivery service foundation has changed over the last two decades in two significant ways. Namely, private industry has begun to play an increasing role in information production and transfer, as has the use of distributed Information Communication Technologies (ICTs). Associated with this new paradigm is the increased use of *farmers' groups* for agricultural extension. Extension officers are now seen not as just as scientists or technology experts, but rather as agricultural information facilitators. The growth in influential farmer-controlled groups has resulted in farmer participation in research and extension, leading to new approaches where information flows and participation of agricultural stakeholders in adult learning principals are emphasised (Marsh & Pannell, 2000; Gianatti & Carmody, 2007). This is important since farmers are able to have control over the information they require and in which format. March and Pannell (2000) described this in terms that extension could be ―demand-pull" rather than ―science-push", which current models of extension and use of ICTs can facilitate well.

Farmer & Grower Groups

Farmer grower groups are community based groups of farmers that come together to tackle issues related to agricultural production at a local and regional level. Many tasks are performed by grower groups in rural areas, including recognition of locally raised issues to be investigated, knowledge sharing between members, and the provision of feedback to researchers on new innovations and technologies (Gianatti & Carmody, 2007). Grower groups and their networks are effective research partners and are valuable networks in the process of implementing outcomes of research (Gianatti & Carmody, 2007). It has been documented that grower groups are very successful in trialling and promoting strong research-based technology (Ridley, 2005).

Group-based extension has many strengths providing farmers with information about the relevance of new farming systems or new innovations, allowing them to work through practical adoptions with support from their peers (Marsh & Pannell, 1998a). Moreover, the Grower Group Alliance (GGA), developed in 2002 by grower groups maximising collaboration and information sharing, is better connecting grower groups, research organisations and agribusiness in a network across WA. The GGA is funded by the Grains and Development Corporation, and is managed by an advisory committee (Grower Group Alliance, 2007).

Farmer groups are represented by a wide typology ranging from non-profit marketing cooperatives, through industry and regional groups, to commercially oriented organisations such as the Kondinin Group (Marsh & Pannell, 2000). Where government support for has declined there has been an increase in investment in participatory research through farming grower groups. Examples include the GRDC investment of $6.5 million a year into farming systems projects; and other research bodies such as Meat and Livestock Australia and Australian Wool Innovation, who have also increased their level of research investment. Many grower groups are moving rapidly from the traditional ways of involvement in funded research as collaborators through government agencies to taking the initiative and applying for government funds as the lead organisations (Marsh & Pannell, 2000). With this shift

has come new methodologies in the communicating and sharing of agricultural information (Gianatti & Carmody, 2007), including a shift away from governed centralised models of storing and disseminating agricultural information to a de-centralised model (Marsh & Pannell, 2000). The continued development of Web 2.0 and ICTs to more personal devices such as smart-phones and tablets has the potential to facilitate this de-centralised model of information sharing like never before.

Information Communication Technologies & Services

Information Communication Technologies (ICT) are electronic-based technologies and/or systems used for the purposes of information transmission, processing and retrieval (Ogunsola, 2005). Their evolution into becoming such a ubiquitous part of modern life began in the early 1990s with the advent of the concept of the World Wide Web (WWW or Web), a system of millions of Personal Computers (PCs) and Servers able to communicate with one another a system of phone-lines – called the Internet – from anywhere in the world. The advent of ‗Web 2.0' facilitated the connectivity of the Web becoming available to virtually any piece of modern technology through the use of installed third-party ―Apps" (applications) and their seamless integration with the hardware and communication channels of today's Internet. Smart-phones with installed Apps communicate seamlessly with purpose built servers to access specific information, such as today's weather forecast. These Apps may also have direct connectivity with similar Apps so that users can combine information from multiple services to aid in their decision making.

Woodgate and Love (2012) have noted a resistance to the adoption of new ICTs by some farming communities, but note too that the next generation of farmers are more likely to already be comfortable with the latest forms of information communication, such as social media and multiple smart phone applications.

In a special report into Telecommunications within the Farming sector in Australia, the ACMA (2008b) asserted that, generally, the farming sector in Australia was relatively well connected, and farmers relied on communication tools such as the Internet and mobile phones for business and personal purposes as much as those

people living in urban/city areas. This was despite rural areas experiencing a limited availability of communication services when compared to their city counterparts. The limited service availability of dial-up Internet services has led to farmers investing in satellite service support. Even with the higher cost associated with satellite broadband technology, 70% of Western Australian farmers rely on satellite services and technologies, with 13% using ADSL, 4% cable broadband and 9% using wireless services (ACMA, 2008b).

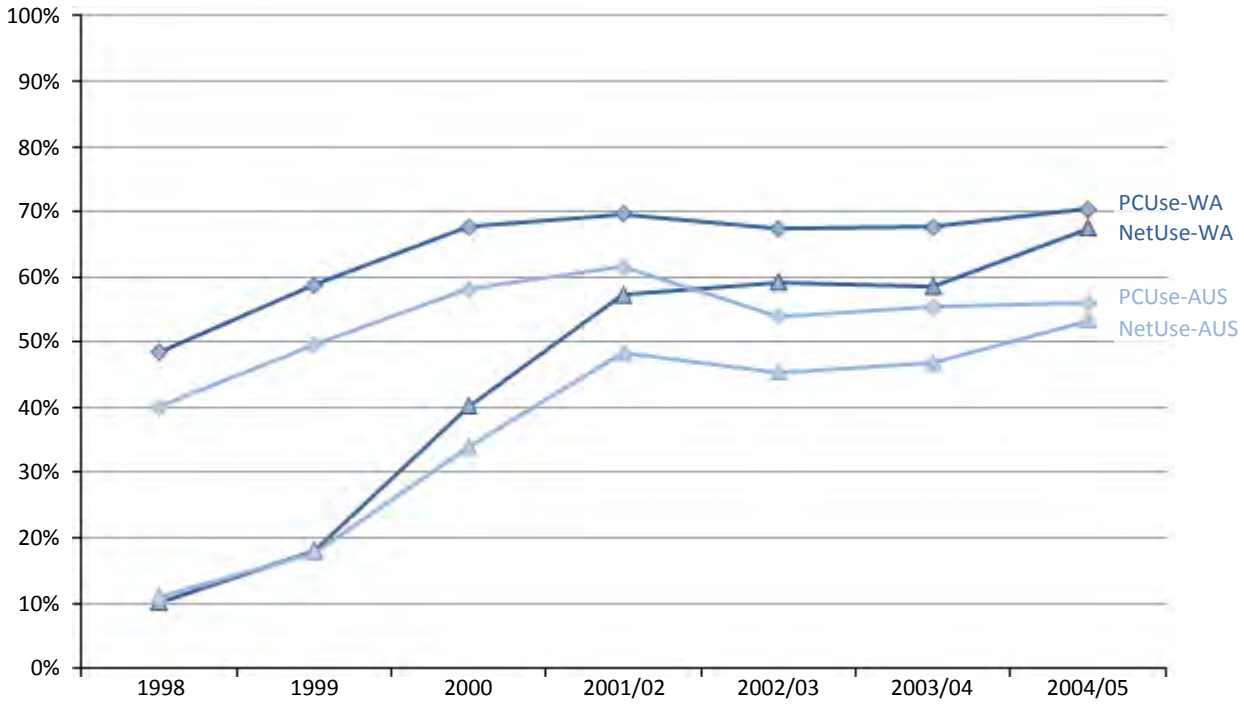

Figure 1.1 Percentage of WA Farmers using PCs and the Internet (1998-2005) [ABS]

Figure 1.1 presents the steady growth in Personal Computer (PC) and Internet use amongst West Australian farmers between 1998 and 2005. Further illustrated is that WA farmers demonstrated consistently higher ICT adoption rates than their Eastern States counterparts. While the isolation of WA farmers might partly explain the higher adoption rates of ICTs, the generally poor coverage of telecommunication services throughout WA (Norton, 2011) means that WA Farmers have had to rely on expensive satellite communication technologies in order to stay „connected". A recent submission by the Western Australian Farmers Federation (Norton, 2011) to the Federal Department of Broadband, Communications and the Digital Economy as part

of the 2011–12 Regional Telecommunications Review report (Sinclair, 2012) indicated that the majority of farmers in Rural Western Australia experience poor telecommunication services. The rural phone infrastructure is poor and the mobile service coverage is inadequate.

Rural, Regional & Remote WA and the National Broadband Network

In 2009 the Australian federal government announced it would build a national fibre-optic network, aptly called the National Broadband Network (NBN), to service Australia's information communication needs well into the 21st Century. According to the ABC (Long, 2011) the NBN is Australia's biggest infrastructure project, with an estimated cost of $43 billion dollars, and will take approximately eight years to build. It is thought that the project will link 93% of Australia's homes and businesses, providing 100 megabits of electronic information per second. The remaining 7% of dwellings in regional and remote areas will be connected through a mixture of wireless and satellite services (Long, 2011).

The Federal Government has stressed that the big winners from the implementation of the NBN will be rural and regional areas in Australia (Conroy, 2009). Moreover, the Australian government has invested $250 million to immediately improve the range and quality of services and the prices of the broadband and telephone services in regional Australia through the Regional Backbone Black-spots Program (RBBP) (Department of Broadband Communications & the Digital Economy (DBC&DE), 2010). In a joint media release (Swan, Crossin & Snowdon, 2011) the government announced that the RBBP would also form "part of the building blocks for the Government's NBN in regional Australia" (para. 7) with the RBBP providing infrastructure capable of supporting the roll-out of the NBN (DBC&DE, 2010).

The new Internet: Smartphone & Tablet Technology & Farmers

The relatively rapid growth of smart-phone based ICT since 2009 has facilitated a new, and decentralised, mode of societal information flow to which farming and agriculture are not immune. The modern mobile, or cellular, phone has been around since the early-to-mid 1990s. The 'smart-phone' is a mobile phone which functions

using an operating system (OS) that allows third-party —Apps" to be installed (PC Magazine, ND)

The current generation of smart-phones became commercially available in 2007 with the release of Apple's *iPhone*, and Nokia's *Nokia N95*. They became commercial viable – i.e., affordable to the large numbers of users, around mid 2008 with the release of Apple's second generation *iPhone (iOS 2)*. This iPhone (called the iPhone 3G), and all other subsequent smart-phones, connected to the global 3G Network and used an App-Store (Android used Google-Play) process to allow phone users to download and install Apps directly onto their smart-phone, effectively removing the need to log-on to a PC to update or install software to their phone.

Utilising purpose-built Apps has allowed smart-phone users to seamlessly integrate their information and communication behaviours with new Internet (Web 2.0) technologies, and the huge growth in the number of smart-phones is demonstrated in Apple's iPhone App-Store download numbers. Through 2008 and 2009 App-Store downloads grew to 1.5 billion (Apple, 2009) and reaching 10 times this at 15 billion by 2011 (Apple, 2011). A study by Google in September 2011 found that in mid-2011 Australians ranked 2nd in world behind Singapore for smart-phone ownership and application use (Moses, 2011), and in 2012 smart-phones and tablets overtook PCs as the most common mode of Internet/Web access.

Currently, very little is known specifically about WA farmers' use of mobile ICTs, although high levels of mobile and smart-phone ownership can be gleaned from some ABS reports, including evidence that WA farmers adoption of ICTs is both earlier and higher than Eastern States counterparts. Even before the most recent mobile-ICT revolution, the lack of quality mobile technology coverage had been identified as a significant issue for farmers based in regional, rural and remote areas of Western Australia. However, WA farmers' higher than national average adoption of ICTs despite experiencing some of the worst Internet and mobile service coverage conditions in the country anecdotally suggests that good coverage is not a driver of ICT adoption. This is consistent with previous ICT adoption theory which suggests

that *ICT-need*, or what Davis (1989) calls ‗Perceived Usefulness' is a stronger driver of technology adoption than readily available coverage, or ‗Perceived Ease of Use'.

We can expect, then, that smart-phone application and mobile/future ICT use will be driven by such things as farmers information needs and the way farmers' use ICT to meet those needs. This study looks specifically at how farmers look for information and which distribution channels they perceive as providing the most accurate, relevant and/or reliable information. In this sense, it conceptualises ‗accurate' information as being a different phenomenon to ‗relevant' or ‗relevant' information (Wang & Strong, 1996; Knight, 2011a) and uses what is learned to indicate how farmers might engage future ICT agricultural information channels.

Media: Newspaper, Static Web-Pages, TV & Radio programs

The need for an information delivery channel specific to Australia's rural information needs has been recognised by the media industry for nearly 70 years, with the Australian Broadcasting Corporation's (ABC) Rural Department producing specialist programs on ABC Radio since 1945. The type of information provided has ranged from information about agricultural markets to rain-fall statistics. The popular *Country Hour* program was first broadcast on December 3 1945 and currently holds the record for the longest running radio program in Australia. Over time *Country Hour* became so popular it evolved into separate State-specific weekday broadcasts regarding agricultural information and advice (ABC-Rural, 2011a). In 1999 the ABC Rural Department opened its online gateway, www.abc.net.au/rural, and maintains developing and adapting new channels of information and communication technology to rural, regional and urban areas Australian-wide (ABC-Rural, 2011a).

Other specialist Radio/Media broadcasts aimed at farmers include the Grains Research and Development Corporation (GRDC) *Driving Agronomy*, which airs the latest grains research information on radio stations throughout rural WA, New South Wales, South Australia and Victoria (Grains Research and Development Corporation, 2012).

Multiple methods of information delivery currently available are information and extension services provided by Department of Agriculture and Food WA (DAFWA), Commonwealth Science and Industrial Research Organisation (CSIRO) and various grower groups, and can take the shape of organised forums, field days, seminars, farm visits and workshops, all of which are a recognisable way of disseminating agricultural-related information, issues and challenges to the industry. The GRDC bi-monthly *Ground Cover Magazine* published free of charge to its members and includes a high quality format CD containing information about relevant subjects broadcast on the local radio. The magazine also contains technical information, research updates, information on trials and new varieties, farmer activities and case studies. Brochures and emails are also sent to members on a regular basis (Grains Research and Development Corporation, 2007).

The extent to which these information and extension services – particularly those run by government departments – are actually utilised by the farming sector in WA has not been independently or empirically investigated. Some subjective evidence does exists that there are good working relationships between the state Department of Agriculture (DAFWA) and various parts of the private sector, for example, Agriculture WA's *Agmemos* publishes names of experienced agricultural individuals who could be substitute sources of advice. A further example can be seen in the working relationship between researchers, extension workers and WA farmers in the setting up and conducting of field trials to conquer seeding problems of lupins in the Eastern Wheat-belt (Marsh & Pannell, 2000). However, there remains a number of challenges facing grower groups; according to Gianatti & Carmody (2007, p.172) these include: finding the right balance between both the individual, group and the network information flow, defining roles and responsibilities, funding, and ability to evaluate the effect of the information disseminated to members through grower group networking (Gianatti & Carmody, 2007). How the new mobile ICTs can facilitate some of these issues will be explored in this thesis.

1.2 Purpose of the study

This study will focus on how farmers in WA prefer to receive their agricultural information and in which formats by examining the context of their adoption and use of ICTs. The purpose of this study is to:

a) investigate how stakeholders interact with various ICTs by examining which ICTs are engaged for specific types of agricultural information retrieval.

b) investigate how information format and delivery impacts farmers perceptions of information quality related characteristics such as information accuracy, relevance or reliability.

1.3 The significance of this study

1.3.1 The Agricultural Industry

According to the World Bank (2011), the world-wide agricultural sector remains a primary driver for economic growth. Agriculture in Australia also plays a vital economic role. For the period of 2009–2010, estimates from the Australian Bureau of Statistics indicated that Australia's gross value of agricultural commodities produced was $39.5 billion (Australian Bureau of Statistics, 2011a). The growth of farm sector was "a key reason Australia avoided a recession during the global financial crisis" (National Farmers Federation (NFF), 2012, p. 3). However, the challenge for Australian agriculture is to meet the need of food to the world growing population "at a time when we have less arable land, less water and less human resources" (NFF, 2012, p. 3).

1.3.2 Information/Data issues in Agriculture

Reddy (2008, p. 2) stated that, "information can best be considered as a productive resource, potentially limiting and influencing the efficiency of production". The author further postulated that "food security is the foundation for social security" (Reddy 2008, p. 3). Consequently, accessing reliable and accurate information in the right format at the right time can contribute to the success of an agricultural industry. In WA, for example, crop growers are dependent upon timely information when making their crop variety choices (Armstrong, Diepeveen & Vagh, 2007).

Dissemination of up-to-date information to agriculture stakeholders is crucial to the industry‘s success, and provision of information in formats that will be most useful for farmers is essential, even if-as suggested in previous studies information dissemination in multiple formats is costly (Licht, & Martin, 2006). Determining the formats in which stakeholders want to receive agricultural information will benefit not only the recipients but also assist the information providers. Research is necessary to understand WA farmers‘ information needs, and this thesis provides the opportunity to explore this area.

A crucial element of this research is to secure the opinions, preferences and ideas of the stakeholders themselves in order to inform the future direction of methods for agricultural information dissemination. Derived from this are the research questions, formulated to target the most relevant data and with the hope of producing the outcome most needed—the provision of timely, relevant, accessible information and in format familiar to WA farmers. Improved agricultural information relevance and dissemination should assist stakeholders, for example with crop price volatility, new innovations and to confront new challenges such as climate change.

1.4 Discussion and Application of this Study’s Results

In the last 10 to 15 years, there have been significant changes to the role of the agricultural public and private sectors in Australia. The role of government-funded agricultural extension has also changed, which has opened the door to the private sector to play a bigger role and have more control and influence. The government, in some cases, is moving towards a coordination of the extension service provider role, and in other cases is moving further away from centralised information and extension repositories. Even so, some sectors believe the government has an obligation to ensure that the information dissemination of research programs occurs even if those programs were not undertaken directly by it.

The reduction in public extension funding has been dramatic, and has led to funds being sourced more and more from farmers‘ levies and other private agencies. And so, extension ideology has changed, and facilitates calls to give farmers more control over the information they need or want, as well as over the way this information is

delivered. This shift to a decentralised model of information production, delivery and retrieval has historically coincided with an even more significant decentralisation of information exchange processes using constantly evolving ICTs. As a consequence of this there has been an increase in the use and influence of farmers‘ groups for agricultural extension as well as increases in farmers participating in research extension.

In summary, the three main changes that have influenced information flow – conceptualised in this study as information production, retrieval and interaction – within the WA agricultural sector during the past 10 to 15 years are:

- the reduction in government funds that has led to the increase of privatisation of the agricultural sector, which in return resulted in
- growing numbers of private organisations and farmers-based grower and research groups; and
- the rapid changes in Information and Communication Technology (ICT) and the way modern society searches for and engages information.

This study has investigated and will discuss the results to surveys of Farmers in Western Australia in the context of these changes in agricultural information behaviour.

1.5 Conceptual Framework & Research Questions

This study will examine the following research questions:

RQ 1. How can ICTs applications/technology devices and supporting infrastructure be used to support WA farmers‘ decision making?

RQ 1a What types of information do WA farmers retrieve?

RQ 1b What are the preferred modes of farmers‘ information retrieval?

RQ 1c How have preferred modes of information retrieval changed over the past 10 years?

RQ 1d How can agricultural information delivery and retrieval be improved using ICTs?

Figure 1.2 uses Knight and Cross‘ (2012) Contextual Constructs Model to develop a big-picture diagram of the thesis‘ conceptual and investigative framework. The

contexts (column 1) of the project's research constructs (row 1) are identified in terms of previous research/models (column 2 & 4) along with the investigative strategies (column 3 & 5) employed.

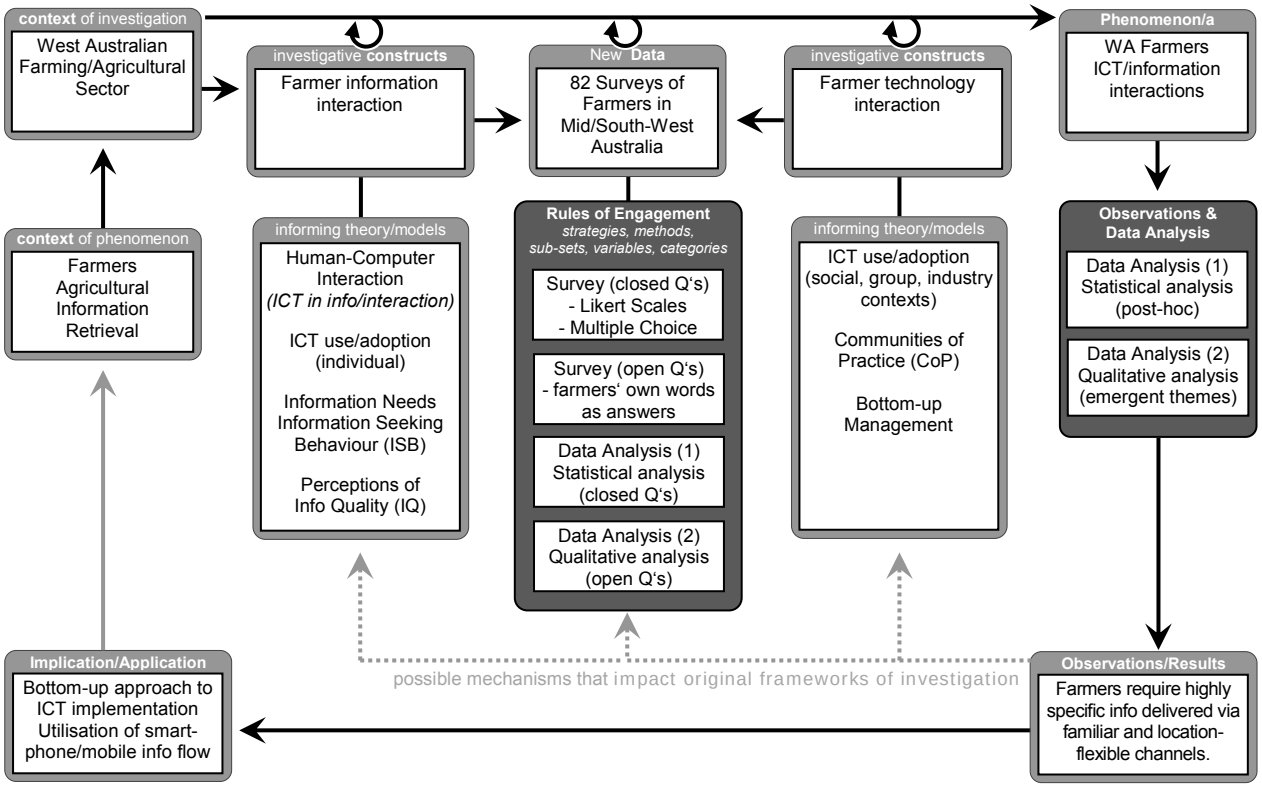

Figure 1.2 Conceptual Framework for the Thesis/Research Project.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter reviews relevant literature in the area of agricultural information dissemination and retrieval in order to address the research questions posed in Chapter 1. The literature discussed will cover both the theoretical basis of information dissemination to farmers, and evidence of the research it has inspired. This review of literature will focus on information delivery mechanisms by examining information drivers, information barriers, information dissemination and its role in value chains; and, finally, similar studies related to information dissemination within agriculture.

2.2 Information delivery mechanisms

There are many ways to deliver information to agriculture stakeholders, and perhaps as many barriers to that delivery. The way information is delivered is becoming faster and more complex with the recent developments in information technology. Information can be delivered electronically through the Internet, telephone lines, mobile phone technologies, radio and audiovisual resources. The more traditional ways of delivery are via printed materials such as letters, brochures, and newspapers. Other common methods of delivery are face-to-face meetings (individually or at conferences), suggesting that traditional information dissemination has not been fully replaced by modern information and communications technologies (Licht, & Martin, 2006; Woodgate & Dook, 2002).

Oliver, Ashton, Hodges and Mackinnon (2009) surveyed broad-acre farmers producing large-scale crop operations throughout Australia. The study found that both livestock and grain farmers used a variety of information sources but most commonly used other farmers, family and friends. Interestingly, 37% of livestock farmers used the Internet, while it was used by 45% of grain farmers. The other two most important information sources for both the livestock and grain farmers groups were agriculture industry-specific media and general media sources (Oliver, et al., 2009). Kashem (2009) reached a similar conclusion when he studied farmers in

Bangladesh, finding that 91.4% of the farmers studied relied on other neighbours and friends to receive agricultural information.

In their study of information dissemination in an agricultural context, Armstrong & Diepeveen (2008) divided farmers into two groups: traditional farmers and innovative farmers. Traditional farmers, the authors asserted, are those who prefer the use of —printed materials, have limited skills in the use of the Internet, and/or are limited by access to the Internet. These farmers also prefer … face-to-face contact with other growers and agricultural consultants" (Armstrong & Diepeveen, 2008, p.11-12). Innovative farmers collect their information using different sources in diverse formats, have the skills to search the Internet, and use other decision tools and systems (Armstrong & Diepeveen, 2008). Similarly, this _innovative' group is referred to by Partridge (1991) as an educated group who are, the author stressed, more likely to use a variety of information channels. Partridge also explained that information seeking behaviours can be influenced by other factors, such as age and gender. Burling (2000) found that non-economic matters, such as demographic, geographic and historic factors may also have a significant role to play in farmers decision-making.

Bardon, Hazel & Miller (2007) identified five distinct groups of farmers based on their information delivery-method preferences. The authors described each group as follows:

> The "Don't Bother Me" cluster is unlikely to use any information delivery method. The "Snail-Mailers" prefer only mail-based information delivery. The "Short-Mailers" prefer mail-based materials and short programs. The "Web-Mailers" are most likely to use mail-based information and the Internet. Finally, the "Fan Club" cluster will likely use any information delivery method (Bardon et al. 2007, para. 12).

A study by Licht & Martin (2006) found that while farmers used a variety of information channels to gather the information needed. It is not always economically possible to use many information channels. The authors concluded that it is important to understand how farmers gather information, and that knowing information gathering methods —would enable educators and communicators to select the most efficient delivery methods" (Licht, & Martin, 2006, p.20). Popat (2009, p. 1)

stated that "the Internet can play a pivotal role by providing a cost-effective way to deliver information". Hence, researchers, such as Lasley, Padgitt and Hanson (2001), and Dollisso and Martin (1999) support the idea of providing a variety of information channels to deliver information to farmers. Adhikari and Suvedi (2000) also shared the same view. In contrast are authors such as Bardon, Hazel & Miller (2007) and Radhakrishna, Nelson, Franklin, & Kessler (2003), who argued that the most efficient information delivery method should be considered rather than using a variety of delivery methods.

Anderson et al. (2003) outlined the role that government information and library services play in catering for the information needs of agricultural extension officers in New South Wales. The authors added that these services focus on the "development of *Extension Alert*, Extension Portal and other services to NSW Agriculture extension officers, particularly the provision of training in information skills" (para. 3). *Extension Alert* is a database that includes a list of relevant local and overseas material. In 2003 the database had 10,000 records and the resources were available in eight libraries throughout the state. The database can be searched using keywords or subject headings, and articles can be requested online. *Extension Alert* is also available in printed form at six-weekly intervals (Anderson et al., 2003).

Woodgate and Dook (2002) investigated the possibility of using the Internet as a tool to support the information needs of sheep farmers in Australia. The authors also examined the advantages and disadvantages associated with the Internet as a communication tool and information channel. The authors found that disseminating information using traditional ways, such as field days and seminars, is both costly and time consuming; in addition, the information presented is volatile. Since information and new knowledge are ever changing all the time and relatively in fast base. This finding was supported by Karnka's (2006) study which concluded that the Internet was regarded as a useful information source providing more credible information than traditional ways. Woodgate and Love (2012) further supported these findings by suggesting that successful extension should employ a variety of resources to deliver information to targeted audiences to address the issues of

preferred learning styles. The authors further asserted that farmers will adopt new practices if they trust the source of the delivered information.

It is widely believed that the Internet can play a vital role in information dissemination; however, adequate and reliable infrastructure is needed in rural WA to fully rely on this channel. Developing the ICT infrastructure in WA would enable other technology devices and systems to be successfully used—for example, satellite imaging technology. The Commonwealth Scientific and Industrial Research Organisation (CSIRO; 2002) has developed technology that uses satellite imaging to deliver qualitative pasture information, related to pasture growth rate. The technology was trialled in WA in cooperation with the departments of Land Administration and Agriculture. The pasture information can now be accessed through the Internet. This information can help farmers with their decision-making processes regarding fertiliser management, financial management, grazing rotation and other agriculture techniques in relation to the grazing industry. This satellite imaging technology is currently limited to pasture growth and management, and requires the end user to have reliable access to the Internet.

Black (2000, p. 493) examined the strengths and limitations of four agricultural models: the linear _top-down' transfer of technology model, participatory _bottom-up' approaches, one-to-one advice, and formal education and training. Black found that, to access reliable scientific information, the linear information transfer of technology model was needed in combination with a bottom-up approach that allows for farmers' participation in research and development processes. The third model was equally important, whether information exchange was from farmer to farmer or professional advisor to farmer, so too formal education and training. Black's main conclusion was that no single model would be adequate by itself, and that new ICT will assist to a certain degree, but will need to be supported by other extension strategies. Csótó (2011) suggested that involving farmers during the development of an ICT application or system, which is the bottom-up approach, is necessary because knowing the users' needs is essential to the success of the application or system. Consistent with Csótó, this thesis aims to investigate farmer's agricultural information needs from the

perspective of farmers in Western Australia (WA). Agriculture stakeholder information needs, levels of education, and farming practices are different from country to country, and even from region to region. These differences can play a critical role in deciding upon the appropriate methods of information delivery to stakeholders and need to be taken into consideration.

As part of the discussion on information delivery mechanisms, it is important to highlight information drivers and information barriers. Explaining the former will give an overview of available information drivers to WA farmers; examining the latter enables researchers and information providers to find solutions to these barriers. The following section will give a brief overview of information drivers and information barriers in the agricultural context.

2.2.1 Information drivers

Drivers and recognisable benefits are needed to induce a targeted group of people to try something new or change a practice. Woodgate and Love (2012, p. 1) asserted that "basic marketing theory says that a change of practice by a target is usually motivated by having to satisfy a need". The authors added that "effective messages should motivate, and make clear the potential benefit or relative advantage due to the product or change in practice" (Woodgate & Love, 2012, p. 1). According to Sindir (2005), Turkish farmers were willing to adopt new technologies when they perceived the benefit derived from such adoption.

Perceived reliability of the information sources has also been suggested as an important factor to farmers adopting new methods and new technologies. Bell (2002) explained that unfamiliar information channels are likely to make farmers reluctant to try or experiment with new methods; but that, farmers are willing to accept new methods from trusted information sources. This was confirmed in Elsey & Sirichoti's (2003) study asserting that credibility of information channel was ranked second for applying new knowledge to farming practices. According to Rossi, Caffi and Salinari (2012, p.464) "decision-support tools use a variety of delivery networks including word-of-mouth, newsletters, recorded phone messages, facsimile (fax), electronic mail (e-mail), short message services (SMSs), and web sites". The authors further

explained that information delivery systems are classified as push and pull systems; the former provides information from distant source delivering information to the user; while the latter requires users to ask for the information to be delivered. Environmental and general crop condition warning services are offered to farmers on regional scale and use both push and pull approaches, as in most warning services one way communication is used, but in some instances two way communications are used when ‗information base' and ‗constrain man[a]gement' are both involved. On the other hand, TV, radio and newspapers are used in push type approach (Rossi, Caffi & Salinari, 2012. p.465).

Warren (2004, p. 2) explained that "ICT was seen as a driver of change"; however, the author emphasised that communities as the targeted group need to be involved and that they need to trust the services and the technologies available to them. The author added that "the reliability of the sources of information on which decisions are based will be the test of the long-term investment in ICT" (Warren, 2004, p.3).

Available ICTs to farmers to help them with their decision making process are well documented, for example, the GPS related data for tracking livestock and areas currently harvested, ongoing satellite imagery of crop conditions and weather forecast data, short and long term (Swain, Friend, Bishop-Hurley, Handcock & Wark, 2011). Smart-phones and the advantages that this device has are revolutionary. According to Consumer Federation of Australia (2012, para. 4),

> The number of mobile services operating in Australia—30.2 million at June 2012 for a population of 22.8 million! Not surprisingly, use of smart-phones and mobile Internet are key driver—smart-phone uses reached 49 per cent of total adults at May 2012, up from 25 per cent at June 2011.

The ABS (2009) recorded that in 2007–2008 73% of WA farmers used the Internet on farms for business and other personal matters. The Australian Communication and Media Authority (ACMA) (2008a) found the percentage of Internet usage by Western Australian farmers was 78%. Chapman, cited in Australian Communication and Media Authority (ACMA 2011a, para. 5), stated that:

> Australians continued to diversify their use of communications with increasing numbers adopting multiple communication devices to suit their particular lifestyle and professional needs. This is most evident in the increased adoption

of voice over Internet protocol (VoIP), mobiles, the Internet and other specific communication channels (such as social networking) in addition to the fixed-line telephone

In 2010–2011 the number of mobile devices in Australia increased by 9% reaching 24.5 million, broadband services increased by 39% and ADSL Internet services increased by 7%. This surge in mobile technologies was accompanied by a decline in the number of fixed-line telephone services from 10.59 million to 10.54 million. (Australian Communication and Media Authority, 2011a). According to the Australian Communication and Media Authority report, 58% of mobile users have a 3G phone and 37% have a smart phone, and as of April 2011, 59% of mobile phone users were aged 18–24. Moreover, 90% of smart phone users accessed the Internet using their mobile phone (ACMA 2011b).

Much of the literature (Jones & Garforth, 1997; Marsh & Pannell 1998a; Warren, 2004; Kalusopa, 2005; Munyua, Adera & Jensen, 2008; Woodgate & Love, 2012) suggests that ICT can play an essential role in information delivery; however, adequate infrastructures are needed as well as the need to train end-users in this case WA farmers—to use new ICTs to search for required agricultural information.

2.2.2 Information barriers

Different studies related to agricultural information dissemination have identified variety barriers to end-user ICT adoption (Margono & Sugimoto, 2011; Kari, 2007). The barriers identified include demographics, inadequate ICT infrastructure, economics, political and geographic factors. Other barriers include human resources development (such as extension workers); type of farming activities and farm size, and poor awareness of available information (Margono & Sugimoto, 2011; Csótó, 2011; Kari, 2007); time to manage and interpret information collected/retrieved by farmer (Fountas, Pedersen & Blackmore, 2005).

Margono and Sugimoto (2011) found that barriers to communication between the extension workers and the Indonesian government were significant. The authors explained that extension workers are the mediators between the Indonesian government centres and the farmers in the transference of agricultural technologies

and agricultural information. The authors believe that adoption of new technology by farmers need to be developed according to the targeted group as well as the location of the targeted group, thereby sharing the same view as Csótó (2011), Yongling (2004) and Clarke (1997). Margono and Sugimoto (2011) list a number of barriers that need immediate attention, such as budget, human resources development, information content, tools and decentralisation. According to the authors, farmers and extension workers surveyed stated that there is a lack of up-to-date information regarding market prices and agricultural products. The study concluded that agricultural information needs to be accessible by the extension workers to enable them to play their crucial roles in bridging the gap between the government information centres and the end user. In addition, Margono and Sugimoto (2011, p. 103) stated that "extension workers need a portal site where they can access not only secondary information but also primary information".

A study conducted by Csótó (2011, p. 25) investigating barriers to the adoption of ICT among farmers by exploring "information flow, information strategies, information literacy and the characteristics of the farm and the farmers" concluded that issues influencing the use of ICT have not changed since the commercial availability of personal computers 30 years ago. Csótó suggested that every farm is different, and every farmer has different information needs—no one solution fits all. Csótó (2011, p. 33) added that farmers need to be involved during the development of new ICT applications; hence, "studies aimed at the improvement of the situation of agriculture with ICT tools must be centred on the human element (and information)".

Fountas, Pedersen & Blackmore (2005) believed that advances in information and telecommunication technologies, have enabled farmers to obtain a large amount of site-specific data about their field to help them in decision-making processes. However, the authors asserted that farmers face problems in managing the data they collect as they have insufficient time to analyse and interpret the information. Gudza (2010) suggested that there was a need for new channels for information dissemination to farmers in African countries, which have limited road networks and poor communication infrastructures. The author explained that many farming

communities in these countries have no access to the Internet, no radio or television signals and some communities still require basic electricity. The author also explained the need for information delivery methods that are affordable, easy to use and allow users to state their own information needs and share knowledge. Oladele (2006) who focused his study on Nigerian farmers argued that diversity of languages was the main barrier faced by information providers to farming communities. The author recommended "multilingual sources to ensure farmers' access to agricultural information" (Oladele, 2006, p. 199).

Methods of delivery, levels of farmer education, a farmer's age and personality, economic and political factors, all have a direct impact on information dissemination for stakeholders. The literature to date has investigated barriers to information delivery to farmers in rural areas in specific locations, countries, and even regarding specific crops. Therefore, the findings of these studies can only be applied to the particular situation and purpose for which the study was conducted. This study represents the further work needed to highlight information dissemination barriers in the context of currently technologies available to stakeholders in Western Australia— which will also likely have application to farming communities in similar sectors throughout Australia as well as other developed economies.

2.2.3 Information dissemination and value chains

It is necessary to define the term 'value chain' before reviewing the related literature. Rayport and Sviokla (1995, p. 79) defined the value chain as "a model that describes a series of value-adding activities connecting a company's supply side (raw materials, inbound logistic, and production process) with its demand side (outbound logistics, marketing, and sales)". Deardorffs' Glossary of International Economics (2010, para. 3) suggests value chains can be defined generally as "the sequence of activities that a firm undertakes to create value, including the various steps of the supply chain but also additional activities, such as marketing, sales, and service". When the term is applied to agriculture, it usually means "all businesses and processes that are part of manufacturing a finished product from raw materials to end-user" (Wisconsin Manufacturing Extension Partnership, n.d., para. 1).

Information dissemination plays an important role in the value chain process. Rayport and Sviokla (1995, p. 75) explained that in today's society every business competes on two frontages; physical resources and virtual world that made of information. According to Cachon and Lariviere (2001) the value of a given decision depends directly on what the decision makers know; consequently, effective operation of the supply chain requires accurate information dissemination. This view was shared by Fox, Barbuceanu & Teigen (2000), when they linked the ability to manage the tactical and operational level of the supply chain with the accurate and timely dissemination of information.

Hellina, Kelemanb & Atlina (2010, p. 262) suggested that "a value-chain analysis can provide useful guidance to crop-breeding programs, providing plant breeders with information on agronomic characteristics required by producers and quality traits demanded by the market". Bryceson (2008) investigated the value chain of bush tomato (BT) and wattle seed (WS) production in Australia to assess the current and future markets. The author concluded that the major value chain problems identified in the BT and WS product chain centred around information flow "which involves trust development, communication issues and power disparities within the chain" (Bryceson, 2008, p. 22). Schwolow & Jungfalk (2009) have illustrated a general information value chain, as seen in Figure 2.1, which comprises eight discrete activities. The authors explained that well-managed information resources are likely to create two scenarios: one is based on lower information-related costs; the second is likely to result in the creation of information asymmetries, in which useful information exists but is not easily available to those who need it. The authors stressed that information plays a crucial role in defining an organisation's competitive and economic position; information is a strategic asset which has direct impacts on an organisation's financial results. Finally, the authors asserted that 'Information Requirements' in the information value chain model, as explained in Figure 1.3, is the most important element because, "any analysis of the efficiency of a primary or support activity, or action towards improving it should be preceded by a thorough information requirements analysis" (Schwolow & Jungfalk, 2009, p. 44).

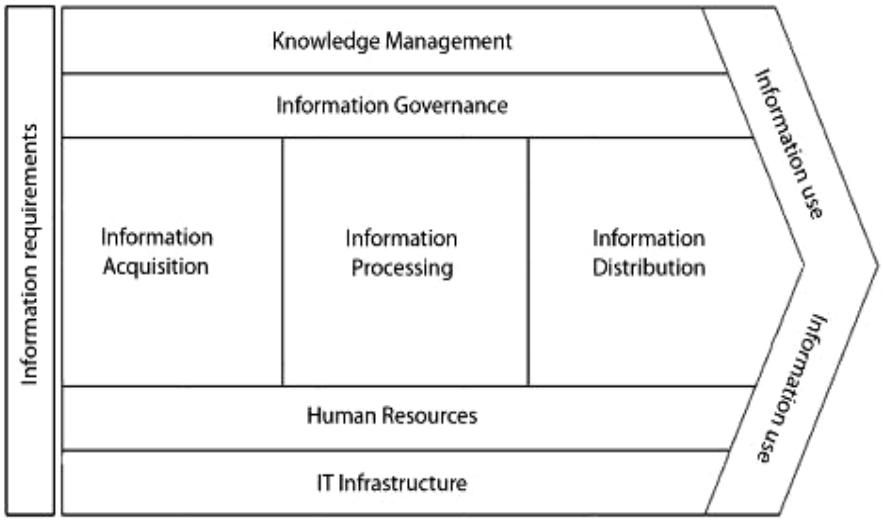

Figure 2.1 The information value chain (Schwolow & Jungfalk, 2009, p.39)

Schwolow & Jungfalk (2009, p.4) explained that Organisations face information-related challenges, —such as information overload, findability, information quality, information architectures, etc. At the same time, they realise that information, eg, about customer preference and needs, brand image and employee satisfaction has become mission-critical to running and sustaining their business". The challenges illustrated by Schwolow and Jungfalk, can apply to farmers information needs and how agricultural related information are accessed and retrieved with all the challenges farmers are facing in relation to agricultural related information. Schwolow and Jungfalk (2009) provide a simple but plausible analytical model which can be applied to the context of the Western Australian agricultural industry context

2.2.4 Community of practice (Cop)-Using grower groups

It is clear from the literature that the value chain plays a vital role in information dissemination and farmers' decision-making, especially when information available is adequate and matching farmers' needs. At an whole-industry level agriculture in WA could be conceptualised as multiple organisational-level information value chains (as seen in figure 2.1). These segments of the industry are described as —Farmer Groups" and work a lot like Communities of Practice (COP).

According to Wenger (1998, p.1) ―communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". The author added that community of practice (COP) is not a simple form of friends or group of people that comes together; it is more connected and have identified identity and shared area of knowledge. This definition applies to grower groups that formed due to changes in the public sector as explained earlier in Chapter 1. These groups come together to tackle issues faced by farmers on local levels, interact with each other and share knowledge; they share stories, experience, and tools (Wenger, 1998). Oreszczyn and Lane (2006, p.5) explained that farmers learn from ―interactions with a like minded community and such communities help to form their identities within the wider farming community."

Gianatti & Carmody (2007) have outlined the activities performed by grower groups to form a partnership with other grower groups, researchers and private industry in Western Australia. They described the role that grower groups and grower networks can play in research projects, demonstrated by case studies of successful corporations. They also asserted that a new and more adequate approach is needed to replace the existing partnerships between different grower groups. Gianatti and Carmody (2007, p.1) believed that ―the most successful projects occur when farming systems groups and research providers develop and implant a new project together". Gianatti and Carmody concluded with an explanation of the potential challenges for grower groups' networks. The aim of the grower groups must be to deliver benefits to their associates through their activities. This can be achieved by balancing both individual group aims and network aims. Moreover, future funding is required to employ the network coordinators and also to organise activities. The authors stated that the success or otherwise of a collaborative project depends on clarification and communication between partners; therefore the authors emphasised that delineating roles and responsibilities is essential at the beginning of the project. In addition, the authors believed that there should be a restriction and limits on farmers' member time. They also stated that there should be measurement of the impact of the information delivered through grower group networks and that because farmers obtain their information from various sources, farming practices could change.

While the project is a step in the right direction, it is new further research is needed. Moreover, to overcome the challenges the authors stated that, more work needs to be done, especially as far as information dissemination to stakeholders is concerned.
In conclusion, farmers approach their needs for information differently, and systems that have been developed or implemented were designed to suit a particular climate, farming practices and farmers‘ knowledge. WA farmers are no exception; their information needs should be addressed accordingly, applying knowledge and technology suitable to their farming practices and conditions.

2.3 Similar studies

This section will provide a review of similar studies relevant to this research. This review will focus on, disseminating of information to WA farmers, and using grower groups.

2.3.1 Dissemination of information to WA farmers

Lloyd (2001) focused in his study on the mediators between revegetation information providers and farmers using two techniques—focus groups and email survey—employing both qualitative and quantitative methods. The author claimed that the Department of Agriculture‘s Farm Forestry and Revegetation (FF&R) project uses a mixture of training methods and communication techniques to help mediators‘ access new revegetation technology. In addition, the author explained that the Department of Agriculture in WA is very concerned with the dissemination of revegetation information to the mediators. Moreover, the author stated, ―results indicated the use vs. preference for different information formats. From these results, three classifications of formats were identified: Preferred and Used Information Formats, Least Preferred and Least Used Information Formats and Potential Growth Formats” (Lloyd, 2001, p. 2). The study concluded by asserting that there was a need for more information and training on the topic of commercial agro-forestry. The author listed recommendations on how to improve revegetation information dissemination and training.

Lloyd‘s study is interesting; however, it has targeted a small group on a single topic. There is an interesting conclusion the author made which seemed somehow out of

context: he listed under the *Least Preferred and Least Used Information Formats* a number of points to be the least likely to be used and yet they were also listed under the *Preferred and Used Information Formats*; then he listed them again, in addition to others, under the *Potential Growth Formats.* It is not clear on what the author based these findings.

According to Murray-Prior, Sirisena, Martin, and Rola-Rubzen (2006) WA Wheat farmers use a variety of sources to obtain information; however, most of their information comes from the Department of Agriculture and Food, Western Australia (DAFWA). The authors explained that for most wheat growers, the *Crop Variety Sowing Guide* had been playing a significant role since its initiation in the early 1990s, with 75% of wheat farmers using it. In addition, the study found that 72% of wheat farmers used the *Wheat Book* and 75% used DAWA's farm notes. DFWA staff and publications were rated as the wheat farmers‘ main sources of information on variety and seeding; 39% and 23% of wheat farmers respectively used these sources. However, 40% used DAWA‘s publication on seed varieties, while 7% used those on seed rate. The study by Murray-Prior et al., (2006) is an assessment of the adoption of —high yield packages” (HYP) research conducted by DAWA in 1990. The study focuses on wheat farmers, with only 40 farmers surveyed qualitatively and 100 surveyed randomly over the telephone. As stated by the authors, "the main issue to be addressed in the results include adoption of the elements of the HYPs, improvements in wheat productivity and performance of the DAWA" (Murray-Prior, et al. 2006, para. 4). An issue with this study however is that throughout the article the authors gave different numbers to the farmers surveyed or interviewed. They stated that 40 farmers were interviewed and 100 surveyed over the telephone at the start of the article, with the figure of 48 of farmers interviewed and 92 surveyed by telephone in a later paragraph in the body of the article. This makes it hard to scrutinise the figures presented by the study. Moreover, the study has many limitations, with the low number of farmers surveyed being the main concern.

Farm type, size and locality affect the use of information and communication technology; inevitably, larger farms are better connected than smaller farms. Equally,

WA farmers have adopted new technology faster than other states due to the large areas under management. In addition, there is a general view shared by the farming sector that there is limited availability of mobile coverage and broadband services, which has resulted in a greater reliance on dial-up connections in rural areas (Australian Communication and Media Authority, 2008a).

2.4 Summary of literature review

The literature reveals that the choice of information delivery methods to stakeholders is a complex issue. Some of the literature suggested that multiple channels should be considered to deliver the information needed; others suggested that a variety of delivery methods is not likely to be successful due to economic factors. Moreover, farmers have different information needs and different ways of acquiring appropriate knowledge. As well as different information drivers and barriers, social, economic, personal and political factors also play crucial roles. The literature to date has not revealed a complete picture of the information dissemination resources currently available to agriculture stakeholders in WA. Moreover, the formats in which stakeholders prefer to receive agricultural information have not been studied. From interactions with farmers, and other studies, it is apparent that systems that were developed or implemented for agricultural information dissemination are suited for a particular climate and farming practice. This evidence suggests that research into this area would be viable especially in WA. This research is also novel as there are no studies currently being carried out in Australia, or WA, to investigate information delivery resources and preferred methods of information delivery specifically.

CHAPTER 3 RESEARCH METHODS

3.1 Introduction

The aim of this study was to investigate WA farmers' information needs and the various processes they use to access relevant agricultural related information, from the prospective of farmers. This chapter presents the methodology and associated research strategies used as part of this study. The research methodology concepts encountered will be discussed in the context of a presentation of the various strategies used, which consisted of a survey questionnaire.

3.2 User/Sample Group

3.2.1 Inclusion Criteria

As part of the project aim to learn about the information pathways engaged by the agricultural/farming community in WA, the *target participant-group* for the research was determined to be residents of rural WA, who self-identified as making the majority of their income from agriculture or farming.

Inclusion criteria included: (1) meeting the participant description; (2) owning (and farming) a property in rural Western Australia- i.e., located outside of the Perth-City metropolitan area); and who were (3) aged over 21 years of age- i.e., considered to be independent and running their own – rather than a 'family' farm. Gender, farm size or type, or specific 'rural' location were conceptualised as intervening variables amongst the users participating in this study.

3.2.2 Exclusion Criteria

Exclusion criteria included farmers who might be considered 'dependents', i.e., under the age of 21 and working on their family/parents' farm. In addition, as data was collated participants who owned farms that were especially small, were excluded from some analysis. Finally, participants who – for one reason or another – did not answer significant portions of the questionnaire were treated as outliers and had their data removed from specific statistical and cross analysis.

3.2.3 Recruiting Questionnaire Participants

The participants in this research were farmers from WA. Farmers and were targeted through farmer groups, such as the Moora-Miling Pasture Improvement Group and the Facey Alliance Group, based in Wickepin WA. Both groups are part of the Grower Group Alliance (GGA).

The questionnaires were initially distributed electronically through Qualtrics survey software, by embedding the questionnaire‘s URL in email correspondence with farmer groups and organisations.

Distributing the questionnaire through electronic mean is very convenient as it can reach a wider, distributed audience– as is the case with farmers in Western Australia, and is also cost effective. However, very few farmers responded to these calls for participation so other means were employed to have the targeted group participate in the study. The low response to this call for participants meant that events, seminars and field days organised by the Department of Agriculture and Food WA (DAFWA), Commonwealth Scientific and Industrial Research Organisation (CSIRO) and grower groups were also targeted and the survey questionnaire was hand-delivered to attendees. These events, seminars and workshops were run throughout the year in different places throughout WA.

Unfortunately, during these events the organisers had limited time and busy schedules. In addition, participants did not have time to fill the questionnaires immediately, nor was there enough time for the researcher to approach and speak with the attendees. One farmer group (Liebe group) suggested that I distribute the questionnaire by Australian post with a paid replied envelope and she was happy to send it directly to its members as they have their postal addresses. This became the most successful way to get participants filling the questionnaire.

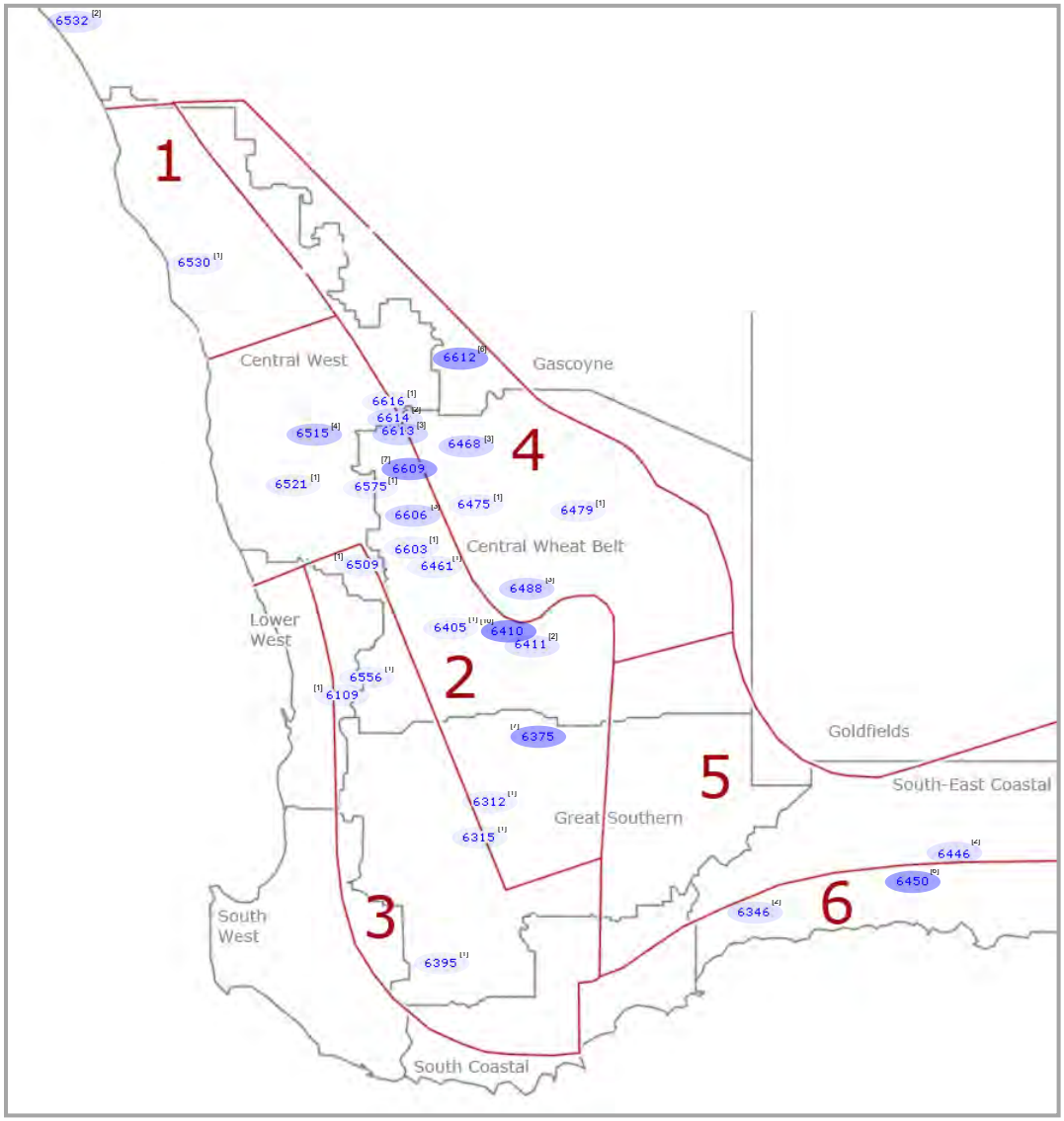

Figure 3.1 *Location of Participants & Six (DAFWA) AgZones in Rural WA*

3.2.5 Informed Consent

The purpose and process of the study were explained to participants prior to the survey/questionnaire, and an informed consent letter was explained and provided to each farmer so that they were aware of their right to withdraw from the study at any stage and to seek their permission to have the research results published if/where appropriate. A total of Eighty-two farmers voluntarily agreed to complete the questionnaire.

Figure 3.1 illustrates the geographical locations across the state of WA represented by the research participants; locations presented by postcode with participants‘ number of each location.

3.3 Data Collection

This research study incorporated two main data gathering techniques, employing quantitative and qualitative evaluations, namely, a survey/questionnaire to collect data about the type of information farmers in WA typically need, as well as common ways they access or retrieve that information. The following sections will describe the methods used to collect the research data.

3.3.1 Survey Research (the quantitative data)

Questionnaire/surveys are a common quantitative method (Kitchenham & Pfleeger, 2001) used to collect data in academia and industry, especially when the research concerns learning numerous people‘s opinions and beliefs (Schmuck, 2006). It is relatively easy to reach a larger sample-group by using a questionnaire, and if the sample is large enough, it is usually possible to generalise from the findings (Schmuck, 2006). Distribution of the questionnaires depends on the tools and resources available.

Electronic delivery of the questionnaire, through the use of Qualtrics online survey software, was selected for this study because it was assumed this method would make it easier for distant farmers to participate. Evans and Mathur (2005) advocated that online surveys have significant advantages over previous formats. They believe that online surveys are flexible, low in cost and offer the advantage of not requiring a lot of the respondents‘ time. These views were shared by Duffy, Smith, Terhanian, and Bremer (2005), and Granello and Wheaton (2006). The automatic population of participants‘ answers into a database is particularly useful as is the online accessibility of analysis of participants‘ answers to a researcher or group of researchers (Evans & Mathur, 2005).

There was a noted disadvantage of online-distributed questionnaires if – as was the case in the current study – the target population prove to be less than comfortable

with this format (Wright, 2005). Thus, although Qualtrics online software was ultimately still used by the researcher as part of data-base population, storage and analysis, it was not used as the main method of questionnaire distribution and data collection. Instead, once hard-copy versions of surveys were returned, they were manually put into Qualtrics software for secure online/electronic storage

3.3.2 The Farmer Survey

A survey of farmer-stakeholders was developed to gain an understanding of farmers' information needs, as well as processes of information retrieval and distribution channels within the WA agricultural industry. After obtaining ethics clearance from the university, a pilot survey questionnaire relating to farmers' information needs and sources of the information they use was conducted in early 2011 to inform the study. The pilot questionnaire was sent electronically via email directly to 20 potential participants, of whom 15 answered the questionnaire. Minor corrections to the questions, including the deleting of one question relating to preferred methods of information delivery, which participants felt were a repeated question. –10. Which of the following sources do you prefer to use to access agricultural information? (number each one from the most important to the least important, eg.1 is most important; 2 less important and so on)". Open ended questions were also added to the end of the survey in order to capture information any participants felt was important–but perceived had not been captured in the closed-ended and multiple choice questions.

The survey questionnaire contained two different parts and was designed to be clear, simple and concise while targeting the necessary areas related to the study. Part One covered demographic information, such as age, gender, education levels, and farm locations. This was considered to possibly provide intrinsic variables between the participants that might impact their answers in part two of the questionnaire. Part Two covered farmers' current information needs and usage of the multiple format information delivery resources available to them. In addition, the type of information required, expectations and attitudes towards information delivery using available tools and the preferred methods of information delivery were also included in the

questionnaire. Farmers' awareness of available agricultural information delivery channels was investigated.

Open-ended questions included in the questionnaire gave farmers the option to permit a description of their farming activities and/or details of their properties, as well as their expectations and attitudes towards agricultural information delivery and how that delivery could be improved. The Questionnaire for the research is included as Appendix B.

Closed Ended Questions

Closed ended questions provide possible answers to participants through a selection that most fit their answers (Oppenheim, 2000). Ian (2008) explained that, these types of questions are appropriate when all likely responses are defined in a set of answers. Answering close ended questions are simple and easy as it requires no extra writing for the participants, also collecting and analysing the data is relatively easy. Nevertheless, bias is possible from the choices provided and may also lead to loss of spontaneity and clarity (Oppenheim, 2000; Schmuck, 2006). Feedback from a pilot questionnaire is an important mechanism for ensuring that researcher bias or potential misunderstanding in any questions is addressed (van Teijlingen & Hundley 2001).

Closed-ended questions are generally multiple choice and can involve the selection of a agreement or disagreement with a questionnaire statement–such as in a Likert scale, or the selection of an exact or most appropriate answer from a list of answers to the question or statement, or simply a selection of 'yes' or 'no' to the question or statement.

Multiple Choice Questions

In this study there were nine questions with multiple choice answers some of which required to choose between a "yes" and a "no" answer, others had more choices providing a set of answers that most appropriately fit participants' experiences. In most cases, in the list provided, there was also a final choice "other" where participants could freely write an answer that was not presented in the list of choices. The "other" option, is useful for capturing information the researcher has not included

as an answer choice, can serve to complicate the analysis of questions since it takes away all the initial advantages of the closed-end question (Rea & Parker, 2012). Further, just because a participant does not select —other" does not mean they didn't think of an _other' answer. In addition, there are times – as was the case in the current study – when the —other" is selected, and once described in writing actually neatly fits into one of the multiple choice statements.

Importance/Ranking Scales

Developing ranking scales allows participant answers to be aggregated in ways that allows different types or occurrences of data to be compared and contrasted. Two of the nine multiple choice questions (Questions #11 and #14) utilised a ranking scale technique, where participants were required to select which of the fourteen listed information providers they commonly engaged, and then number each of those providers in order from the most important to the least important information channel to their work as farmers. The top five nominated information channels by each participant were then given a relative score depending where they were ranked so that each channel could be give an aggregated score.

The question asking farmers to rank the importance of various information channels was asked twice, the first time was to capture commonly important information channels for today's farmers and the second time asked participants to rank the information channels according to their views and behaviours a decade ago. The time period covered by these questions then was 2011 and 2001.

Asking the question in this way meant that the researcher could firstly compare the importance of different information channels to farmers, and secondly investigate whether farmers had changed their views over time.

Likert Scales

According to Oppenheim (2000, p. 174) —an attitude is a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli". Attitudes are based on a person's beliefs, which become–usually unconsciously–psychologically engaged and evaluated when a person comes across specific situations, objects or events. In this way, beliefs affect emotions which can lead to

particular behaviours and or emotional responses to stimuli (Eagly, & Chaiken, 1993; Oppenheim, 2000).

In research, attitude and or variables in attitudes can be measured in many different ways. However, attitudes are often difficult to evaluate due to their complexity, and they are not always clear cut (i.e., "yes", or "no" answers) (Oppenheim, 2000). The Likert-scale is one of the relatively easy tools used by researchers to investigate survey participants attitudes (Ian, 2008). In a Likert-scale group of questions, a list of statements about phenomena in a study is presented to participants. After each statement, five, seven, or nine levels of agreement or disagreement are presented. In a five-point Likert-scale, the version of the Likert-scale used in this study, the levels of agreement are usually: (1) strongly agree; (2) agree; (3) neither agree nor disagree; (4) disagree; and (5) strongly disagree (Albaum, 1997).

In this study farmers' perceptions of the *accuracy of information sources* were measured by using a five-point Likert-scale (i.e., "strongly agree" to "strongly disagree"). As with most groups of questions using a Likert-Scale, each position statement can be viewed in terms of its own results, for example; the answers to the single question/statement: "The most accurate information comes from other farmers" (SA, A, NAND, D, SD), but the value of the approach also comes from comparisons between statement scores.

Eleven different information channels were included in the choices offered to participants and the Likert technique used to give participants the options to accurately reflect their view rather than the straight answer (i.e., yes, or no). Likert-scale results are considered reliable (Oppenheim, 2000), although the degree of reliability is reliant on the proper design of position statements to represent the attitude or perception being investigated. In addition, some statements can be clustered together conceptually. In the current study, for example, participant answers for "radio", "rural press" and "TV" could be clustered into understanding participants' attitudes and perceptions of the broad media's capacity to deliver accurate information to farmers.

Open Ended Questions

Four open-ended questions were posed at the end of the questionnaire in order to seek respondents‘ opinions and comments about the issues or problems they have faced when gathering agricultural information. In addition, respondents were asked to provide suggestions to facilitate better information gathering to be used in decision-making processes.

Open ended questions allow participants instinctively to answer questions according their feelings at the time of the questionnaire, providing participants more freedom with their answers. Answers generally have greater detail and richness (Ian, 2008; Oppenheim, 2000), and vary more between participants, but a disadvantage of this is that responses become more difficult to analyse. Another disadvantage to open-ended questions is that they take more time and effort for participants to answer which may result to less participation (Ian, 2008; Oppenheim, 2000; Schmuck, 2006). One way around this, which was used in this research, is to make the open-ended questions section optional for participants.

3.4 Data Analysis

All collected data was entered and stored online in Qualtrics Survey Software, before it was encoded in the statistics analysis application SPSS. Responses to each question were examined first, followed by grouping similar questions together to examine user results according to concepts being investigated in the research. Basic statistical approaches, such as percentages, mean and standard deviations were used to search for expected patterns in the data, followed by post-hoc cross-tabulations using statistical methods such as Pearson Chi-square as well as ANOVAs to obtain findings. Qualitative data, such as the open-ended questions of the questionnaire were then examined using basic qualitative techniques, such as looking for recurring themes in participants answers, to see if they might shed some light on the results found in the quantitative data. The raw data (in terms of aggregated results) collected in the questionnaire is presented as Appendix D.

3.4.1 Quantitative/Statistical Analysis

Quantitative, or statistical analysis is used to investigate whether there are dependent variables in the collected data. That is, do participants' answers to some questions shed light on, or even predict their answers to other questions (Gall, Borg & Gall, 1996).

Initial assumptions & the type of information collected

From the literature review conducted some assumptions were made that relationships might exist between participants results and other characteristics such as gender, farmer age, farm location, size, and type of farming activities. That is, it was assumed that common demographic data might have an effect on farmers information gathering techniques and also the type of agricultural information required. These assumptions are the initial best-guesses at the type of information that should be gathered in the questionnaire and help the researcher to decide some of the questions to be including, including which demographic data and/or farmer information behaviour data to collect.

Gender data was gathered because it is a common variable in most of the literature about how users use ICTs. Age of participants was gathered since most of the literature suggests _younger' users are more comfortable with information technology and therefore more likely to use ICTs. Location of farms was gathered in case there was relationship between farm location and typical farm-type or size, as well as to investigate the impact of Telco coverage and ICT infrastructure support on the investigated issues. It was also assumed that farm size and/or farm type might have an influence farmers information gathering techniques as well as the type of information they need or seek.

Measuring Techniques

According to Stevens (1946) there are four types, or levels, of measurement: —nominal, ordinal, interval and ratio". The study used *nominal measurements* to investigate results in relation to demographic information such as participants' age, gender, and education level; *ordinal measurement* was used to investigate and rank the importance of specific information delivery channels to farmers and how farmer's

perceptions of information channels impacted their information seeking and retrieval behaviours; and interval measurement was used to investigate how aspects of participants' perceptions of information delivery changed over time

Data Cleaning and Collation

Collation of the quantitative data was done using SPSS and MS Excel. In Excel questions were cleaned and checked for validity by:

- structuring the data in each question so answers to the same question could be compared vertically between participants;
- clustering questions, so that concepts could be investigated; and
- removal of outliers and/or data anomalies between questions so that post-hoc analysis could take place.

Figure 3.2 illustrates the cleaning and collation process with Question 9 of the farmer questionnaire which used a Likert Scale technique to investigate farmers perception of where they expect to receive the most accurate agricultural information from.

User#	Q9_1	Q9_2	Q9_3	Q9_4	Q9_5	Q9_6	Q9_7	Q9_8	Q9_9	Q9_10	Q9_11
1	SA	D	SA	SA	SA	SA	NAoD	SA	Ag	SA	NAoD
2	Ag	NAoD	NAoD	NAoD	Ag	Ag	NAoD	Ag	Ag	Ag	Ag
3	NAoD	D	DNA	SA	SA	Ag	Ag	Ag	Ag	NAoD	NAoD
4	Ag	NAoD	Ag	Ag	SA	NAoD	NAoD	NAoD	NAoD	Ag	NAoD
↑ ↓											
82	Ag	Ag	Ag	Ag	SA	SA	NAoD	NAoD	NAoD	SA	Ag
83	Ag	Ag	NAoD	NAoD	SA	Ag	Ag	Ag	Ag	NAoD	NAoD
	Q9_1	Q9_2	Q9_3	Q9_4	Q9_5	Q9_6	Q9_7	Q9_8	Q9_9	Q9_10	Q9_11
SA	20	1	13	11	43	9	4	12	5	11	1
Ag	44	9	44	37	34	45	37	49	34	41	21
NAoD	14	27	14	26	1	18	28	13	27	23	43
D	0	21	1	1	0	0	4	0	7	1	7
SD	0	12	0	0	0	1	0	1	2	0	0
DNA	1	9	7	4	1	6	6	4	4	3	7
Tot	79	79	79	79	79	79	79	79	79	79	79
Can Use	**78**	**70**	**72**	**75**	**78**	**73**	**73**	**75**	**75**	**76**	**72**

SA=Strongly Agree; Ag=Agree; NAoD=Neither Ag or Disagree;
D=Disagree; SD=Strongly Disagree; DNA=Did not answer

Figure 3.2 *Collated data/results for Q9.*

Post-hoc Analysis

Post hoc analyses are concerned with looking for patterns or relationships in a data-set that were not necessarily anticipated or articulated as specific hypotheses prior to data-collection (Hilton & Armstrong, 2006). In so doing, post-hoc analysis is able to look for patterns in collected data that may otherwise remain undetected. In this study post-hoc analyses were conducted using participants general results as well as user characteristics such as gender, age, education level, location, farm size and farm activity sub-groups on the key variables (topics/issues) of interest in order to find out if there were any significant relationships between studied variables–some of which were contrived as part of the questions included in the survey, and others which emerged in the data.

3.4.2 Qualitative Analysis

Data collected from the questionnaire‘s open ended questions were qualitatively analysed to extract themes. Similar themes from participants‘ answers were highlighted to extract findings and were coded for easy analysis. This was done by writing keywords to represent each participant‘s response to specific questions. Emerging keywords were compared for similarities see if they represented emerging themes in farmers answers. These could then be compared to overall findings already recorded in the quantitative analysis. Further, whole statements were also engaged for the purpose of seeing whether they shed any light on the quantitative data results.

Table 3.1 Example of qualitative analysis process from Q #13.

#	Q-13. info deliver has changed ….	MY Words (summary)	themes (tech objects)	themes (behaviour)	themes/ results	prev research themes	prev rsrch themes (IQ dimensions)
1	it’s a lot easier to source via Internet	easier to source info (Internet)	↑NET	↑own (ISB) (choice of *source*)		↑*independence?*	
2	use technology more, Internet, mobile phone	more use of technology	↑NET ↑mobile tech	↑use			
3	quicker information, e.g. mobile phone, Internet, fax.. etc	quicker info	↑NET ↑mobile tech	↑*speed of* info			↑***currency***
4	Yes grower groups better targeting local concerns	GG better target local needs		↑local (GG) networks		↑*independence?*	↑***relevancy*** (local-*scope*)
5	a lot of information gathered from e-news/email and Internet	more info gathered	↑NET ↑email	↑*amount* of info		↑info amount	↑***access*** (amount)

CHAPTER 4 DISCUSSION: Research Results

4.1 Introduction

A total of eighty three (83) respondents provided useable survey responses. They were from the 6 ‗AgZones' in Western Australia as well as the Perth Metropolitan area. This represents 0.76% of farmers in WA (National Farmers Federation, 2012). Four surveys were excluded because of specific exclusion criteria (e.g., survey participants number 10 was not a farmer); insufficient data in some questions (survey participant number 30; survey participants number 47); or duplicated survey/result (survey participant number 44), leaving a total of 79 participant surveys.

A further 8 surveys (survey participant numbers: 32, 38, 47, 49, 64, 69 and 81) did not answer question fourteen, which asked users about their agricultural information behaviour from ten years previous to the survey. It is possible that the question was considered irrelevant by users who were not ‗farmers' a decade ago. For this reason, the 8 surveys were removed from the post-hoc quantitative data analysis techniques, but were included in the analysis of responses to individual questions, except for questions 10 and 14.

4.2 Demography of Participants

4.2.1 The Participants: Gender, Age and Education

Gender

The survey respondents comprised sixty four (64) males (78%) and eighteen females (22%). Table 4.1 presents the gender of participants, which clearly shows the number of male farmers is significantly higher than the female farmers. According to the ABS (2012) year book, between 2010 and 2011, 72% of Australian farmers were male. Furthermore, the proportion of male and female farmers in this study is consistent with that found by Elizabeth and Zira (2009), and Cidro and Radhakrishna (2006)— that the majority of farmers are male. It has been reported in many studies that farming is a male-dominated trade (ABS, 2012; Elizabeth & Zira, 2009; Cidro & Radhakrishna, 2006).

Participants‘ gender was considered in this study to see if there was any relationship between farmers‘ gender and their results agricultural information dissemination survey questions. In the first instance, the participant group confirmed male employment dominancy in agricultural trade.

Table 4.1 Gender of participants

Q1: Gender			
Answer		**#**	**%**
Female		18	22.8%
Male		61	77.2%
	Total	**79**	

Age

The age of participants in this study was collected to determine if there was any relationship with the use of ICT tools. The division of age-brackets was selected starting with the age of 18-20 because of ethical concerns and issues relating to miners under the age of 18. According to the ABS (2012) farmers median ages are higher than all other working industries; therefore, the age-brackets tried to cover as many age group as possible.

Table 4.2 Age demographic of participants

Q2: Age Group				
	Age-group		**#**	**%**
1	18-20		0	0.0%
2	21-25		8	10.1%
3	26-30		13	16.5%
4	31-35		5	6.3%
5	36-40		9	11.4%
6	41-45		11	13.9%
7	46-50		12	15.2%
8	51-55		9	11.4%
9	56-60		4	5.1%
10	60+		8	10.1%
		Total	**79**	

The survey captured a broad age spread among farmers as shown in table 4.2. The largest proportion of participants was 26–30 years old (16.5%), as can be seen in Figure 7. The second largest group was aged 46–50 years (15.2%), followed by 41–

45 years (13.9%). The median age group for the survey participants was 45–60 years.

According the ABS (2012, para. 6) ~~-~~the age profile of farmers differs from that of all employed persons. In 2010–11, the median age of farmers was 53, compared to 39 for all employed persons", which is not consistent with the median age group for the survey participants.

Education

Curtain (2003) asserted that information delivery via ICT can become more difficult due to illiterate and unskilled workers. To explore any relationship between the educational level and the use of ICT tools, participants' level of education was recorded in this study. Participant education data is presented in Table 4.3

The proportion of farmers who had a post-secondary school qualification was 62% (Certificate 26.9%, Undergraduate Degree 15.4% and Postgraduate 21.8%) which is slightly higher than the Australian national average of 59% (ABS, 2012, para. 1) ~~—~~the proportion of people aged 15–64 years with a non-school qualification was 59% in May 2012."

Table 4.3 Education of participants

Q3: Education				
	Completed Ed Level	**Bar**	**#**	**%**
1	Primary School		0	0.0%
2	High School		18	23.1%
3	Certificate		21	26.9%
4	Undergraduate Diploma		12	15.4%
5	Bachelor Degree		17	21.8%
6	Masters Degree or Higher		10	12.8%
		Total	**78**	

The proportion of farmers with Masters or PhD qualifications in the study was 12.8%, which is higher than the national average of 8.7% recorded by the Australian Bureau of Statistics in May 2012 (ABS, 2012). Furthermore, in comparison to other states, a higher proportion of members of farming families in WA have a qualification at the diploma or bachelor degree level in WA (ABS, 2008).

4.2.2 Farms: Location, Size & Type

Geographic Location

Farmers from all six DAFWA regional –AgZones" were represented in the sample of respondents, albeit to different degrees. This included farmers from: Western and South-Western Gascoyne (8); Central West (8), Central Wheat-Belt (37); Great Southern (10); Lower West– inc. Perth Metro (6); and South East Coastal (10). Locations of the participants' farms are illustrated in Figure 4.1. Shown is each farm's postcode and location in terms of both Bureau of Meteorology land areas and DAFWA AgZone.

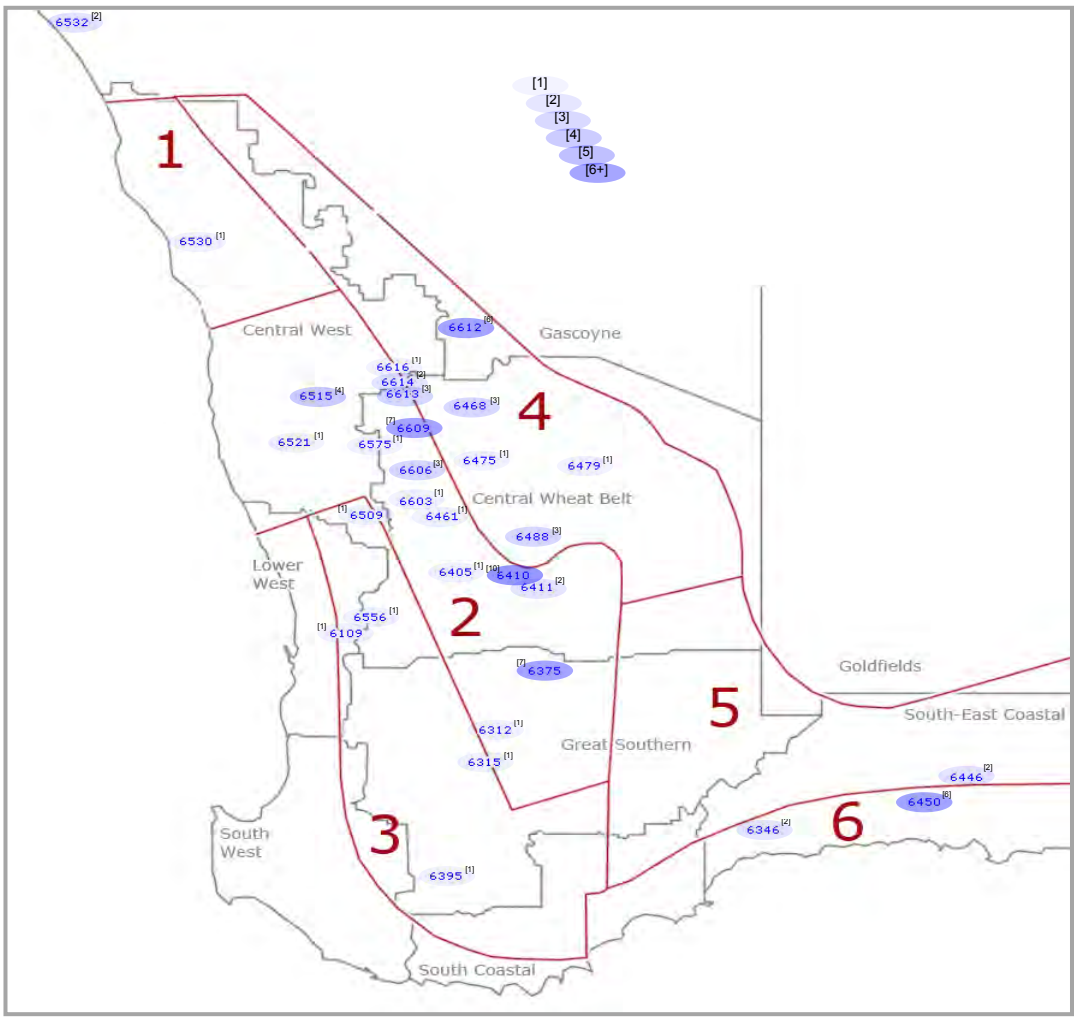

Figure 4.1 Locations of the participants' farms

Farm Size

The ABS (2009, para. 4) reported that –there was a strong relationship between farm size ... and the use of the Internet". Therefore, this study has captured farms sizes to

verify or otherwise the relationship between the farms size, ICT use and other variables in relation to agricultural information need and retrieval.

The total area of Australian farms in 2010 was 390 million hectares. WA has 9.1% of this area (= 35,490,000 hectares; counting all farms including very large cattle farms up north) (National Farmers Federation, 2011). There are 10,889 farms in WA, thus the average farm size is about 3250 hectares, which is a medium-sized farm (National Farmers Federation, 2011). Participants were asked the actual size of their farm in hectors, and were then classified into six groups according to their responses. The classified farm-size groups were; 0–1,000 hectares were classified as very small farms, 1,000–2,500 hectares as small farms; 2,501-5,000 were medium farms; 5,001-7,500 medium-to-large; 7,501-10,000 large; and 10,001 hectares as very large (see Table 4.4). Classifying farm-size like this allows the researcher to cluster results together into meaningful numbers of farmers representing a farm-size, which will allow the research to examine whether the study supports previous literature (ABS 2009; Arumapperuma, 2008) that farm-size influences farmers‘ information behaviour.

Table 4.4 Farm sizes (grouped) of participants

Q6: Farm size				
	Farm size (hectares)		**#**	**%**
1	0,000-1,000 (v-small)		7	8.9%
2	1,000-2,500 (small)		12	15.2%
3	2,501-5,000 (medium)		22	27.8%
4	5,001-7,500 (med/large)		24	30.4%
5	7,501-10,000 (large)		8	10.1%
6	10,001+ (v-large)		5	6.3%
7	NA/Unknown		1	1.3%
		Total	**79**	

The mean average farm size in this study was 5048 hectares. The ABS release of 2009–2010 showed that the total agricultural businesses in WA are 12,465, and in the Perth region there are 1,511 agricultural businesses farming 478,000 hectares. This is down from an earlier estimate by the ABS (2006) that there were 13,475 farms in WA—that is a difference in farm numbers of 1010 hectares. According to Powles (2011) the majority of farmers in WA operate a crop occupying between 2500

hectares and 5000 hectares, making WA cropping farms –among the largest cropping family farms in the world".

According to the Productivity Commission (2005), in the 20 years to 2002–2003 farm numbers in Australia declined by approximately 46,000 farms, agricultural land production declined by about 9%, and the average farm size increased from 2720 hectares to 3340 hectares. This is consistent with the —medium farm size" classification for such a farm in the current research.

Farm size in WA is comparatively unique since farms are relatively large compared to many countries around the world; this is at least in part due to water shortages and poor soil in WA (Moore, 2001). It also implies that farming – as an industry – is big-business in WA. For example, about one-third of Turkish farmers (34.9%) used two hectares or less to carry out their farming activities (Sindir, 2005), indicating that not only is the process of farming different in Turkey, but so too is _being a farmer'. What is not known however, is whether agricultural information needs and farmers information behaviour is different because of these geo/size-differences.

Farm Type

Data regarding farming activities (i.e., type of farm) were collected to see whether this might have an impact on farmers' information behaviour. In addition, farm type was compared with data on farm locations to determine whether types of farming were relatively location specific. The location and farm type was also compared to collected data on known telecommunication coverage. Therefore, the collated data could be used to not only look for patterns in farmers responses regarding their information behaviour and preferred mode of ICT-driven information delivery/retrieval according to farm size and type, but a clearer understanding of the role of potential ICT _coverage' as a driver of ICT adoption could be inferred.

Table 4.5 presents the three farm types in terms of: (1) Crop only farms (21.5%); Livestock only farms (7.6%); and Combined Crop & Livestock farms (70.9%).

Table 4.5 Farm Types

Q7: Farm Type				
	Answer	**Bar**	**#**	**%**
1	Crop Grower (e.g. wheat)		17	21.5%
2	Livestock (e.g. cattle)		6	7.6%
3	Crops & Livestock		56	70.9%
		Total	**79**	
Q7: Farm Type				
4	Total 'CROPS'		73	91.1%
5	Total 'Livestock'		62	77.2%
		Total	**79**	

The small number of farmers surveyed makes the farm-type data less likely to be a realistic sample of farm-type distribution throughout WA; however, it still presents an opportunity to compare (internally) this user-group's farm size with location data. Figure 4.2 and Table 4.6 illustrates the survey participants farm-type distribution in relation to the size of their farm, and demonstrates that the larger a farm gets in size, the more likely it is to be a crop-only farm. That is, the larger a farm gets, the less likely it is to have to supplement its income by including livestock as part of its produce. This is important because previous research has found that user information behaviour is directly related to information tasks being undertaken (Knight & Spink, 2008). Since this research assumes that farmers information tasks can vary depending on the farm-type, farm size may also have an anecdotal relationship with the participants information behaviours through any relationship it demonstrates with farm type.

Table 4.6 Farm size Vs Farm Types

Q6: Farm size					
	Farm size (hectares)		**#**	**%**	
1	0,000-1,000 (v-small)		7	8.9%	combo-4; Lstock-3
2	1,000-2,500 (small)		12	15.2%	Crop-3; combo-8; Lstock-1
3	2,501-5,000 (medium)		22	27.8%	crop-6; combo-14; Lstock-2
4	5,001-7,500 (med/large)		24	30.4%	Crop-5; combo-19
5	7,501-10,000 (large)		8	10.1%	combo-8
6	10,001+ (v-large)		5	6.3%	crop-3; combo-2
7	NA/Unknown		1	1.3%	crop-1
		Total	**79**		

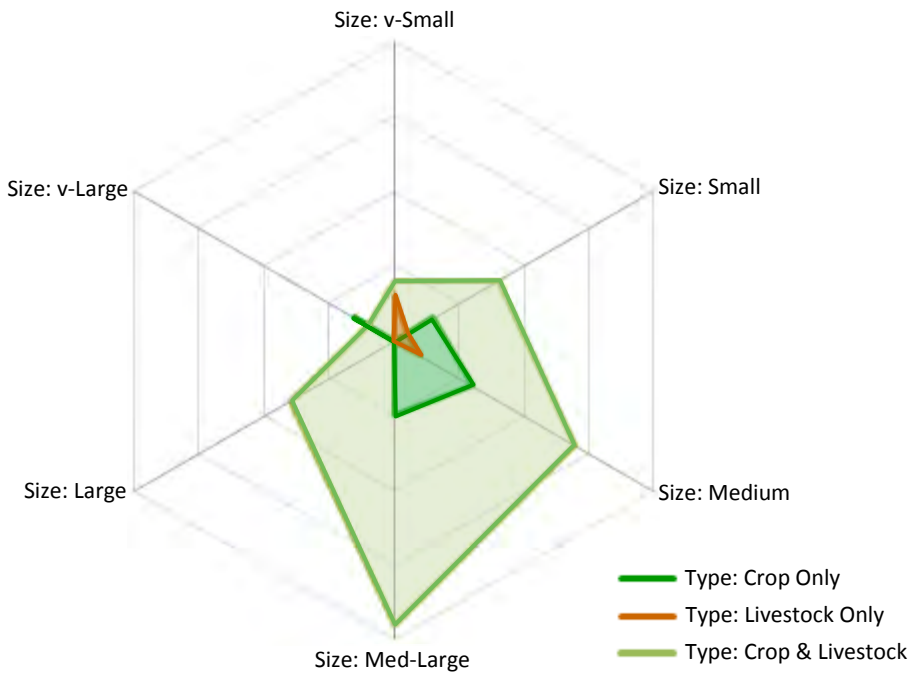

Figure 4.2 Farm size Vs Farm Types

4.3 Agricultural Information Resources Used by Farmers

A variety of information resources are available to agricultural stakeholders from which they can receive, find and retrieve required information. The resources include online resources, CDs, the mobile phone, help lines, videos, radios, printed materials, field days, seminars, and workshops. Printed materials may include news papers and brochures. Other information resources can include other farmers which may be Farmer groups or neighbours, the local library, farmer organisations and agricultural private consultants.

4.3.1 Which information resources/channels do farmers use?

Participants were asked which resources they use to access agricultural information (Q.8). This question did not specify how often farmers accessed these channels so it would be improper to use these results to somehow rank the information channels, however, the results do give an indication how many farmers have at some point utilised specific resources to access agricultural information. The survey showed that Farmer groups (88.6%) were the most widely encountered tool as a source of agricultural information. This was followed by the Internet and related websites (84.8%); Printed materials (81%); and Other farmers (75.9%) (see Table 4.7). The

historical background discussed in 1.1 Chapter 1 showed that Farmer groups were developed over the last two decades as a consequence of a reduction in government funding to public sector information channels, which caused the private sector to take more control, gradually playing a more important role in agricultural information collection and distribution channels. Farmers groups run seminars and field days, it is farmers gathering which can be seen as sharing information between farmers and new innovations presented by invited guests. It can apply to the source —Other farmers" as well and not necessarily other farmers as farmer's neighbours.

Printed Materials came 3rd as far as commonly used information source; however, in later questions (Q 10) it becomes clear that Newspapers are considered to be unimportant to gain required agricultural information, and newspapers are a big part of printed media. Although, the question stated clearly —Local News Paper", the local news paper may or may not be agricultural specific. In later question (Q9) Rural press was considered by farmers to be relatively accurate source of information, it is clear indication that some printed materials still play part in agricultural information delivery.

Table 4.7 Information Resources Used

Q8: What Information Resources are used?				
#	**Info Resource**	**Bar**	**#**	**%**
4	Farmer Group		70	88.6%
2	Internet/website		67	84.8%
9	Printed Material		64	81.0%
7	Other farmers		60	75.9%
10	Personal Knowledge		44	55.7%
5	Radio		39	49.4%
6	Mobile phone		40	50.6%
3	Home phone		24	30.4%
1	TV		21	26.6%
8	Local Library		1	1.3%
11	*Other (specify)*	*inc. consultants/advisor; research/education*	*13*	*16.5%*
	Total		**79**	

4.3.2 Which information providers do farmers consider important

Participants were asked to rank 12 common information distribution channels in order of importance. Farmers were provided a list of 12 information channel options along with an —Other" option where they could include channels not presented in the list.

Farmers chose to answer this question in various ways, with some numbering the choices 1-12 (twelve choices were given), others numbered 1-13 and included a 13th information channel in the _other' choice. Other farmers numbered only their top 3 or 5 providers. Each time an information channel was ranked 1st by a farmer it was given 10 points, 2nd was assigned 9 points, 3rd was assigned 8 points, and so on, until each info channel obtained a total score. This process was imposed on the data to discover what each channel's score would be if users top 7 responses were analysed. Table 4.8 presents the scores given to each information provider using this formula, the number of responses used (column 1), and the number of users (column 14) used to calculate the scores. Row 3 presents the top 5 ranked information providers, calculated using 60 users results, and was chosen as the results for Q10 and Q14 to be discussed in this research.

Table 4.8 Most important information providers to farmers in WA over 10 year period

Q10. Most Important Info Channels (current)													Q14. Most Important Info Channels (10 yrs prev)											
# of ranked results	Other Farmers	Private Co's	Internet/web	Extension worker	Local library	Gov Officer	Brochures	Local Newspaper	Printed material / pubs	Farmer groups	Mobile phone	Personal Knowledge	# of users	Other Farmers	Private Co's	Internet/web	Extension worker	Local library	Gov Officer	Brochures	Local Newspaper	Printed material / pubs	Farmer groups	Mobile phone	Personal Knowledge
7	377	275	317	227	10	123	101	85	308	387	159	254	53	407	270	79	219	328	228	33	165	206	318	18	333
6	371	269	327	226	10	109	64	66	303	404	149	234	56	423	264	50	222	340	220	30	143	164	330	14	327
*5	399	232	325	211	24	118	39	31	266	421	149	221	*60	417	234	51	226	326	229	27	110	145	336	14	294
4	359	224	288	180	18	100	28	7	207	388	119	209	62	387	220	59	222	278	184	22	68	112	286	14	273
3	324	211	260	127	18	93	0	0	130	383	70	186	66	389	201	54	148	253	152	8	26	63	259	0	246
2	275	164	197	95	10	29	0	0	99	313	46	147	69	354	113	38	124	159	120	9	18	47	133	0	206
1	140	110	90	60	10	20	0	0	0	170	20	120	71	220	50	30	70	60	30	0	0	20	70	0	170

From the farmers' perspective, the top ranked providers of agricultural information were: (1) Farmer groups; (2) Other farmers; (3) Internet/Web; (4) Printed material/ publications (e.g., published research); and (5) Private consultant specialists the results for Question 10 indicate that not all information providers are created equal, and that farmers use varying degrees of discernment when interacting with information from specific sources. In addition, when compared with the results for Question 14 – which asked farmers to rank the same information providers in terms of how they felt 10 years prior, we see that these perceptions can change over time.

Figure 4.3 presents farmers perceptions of their most important information and those perceptions have changed over the last 10 years.

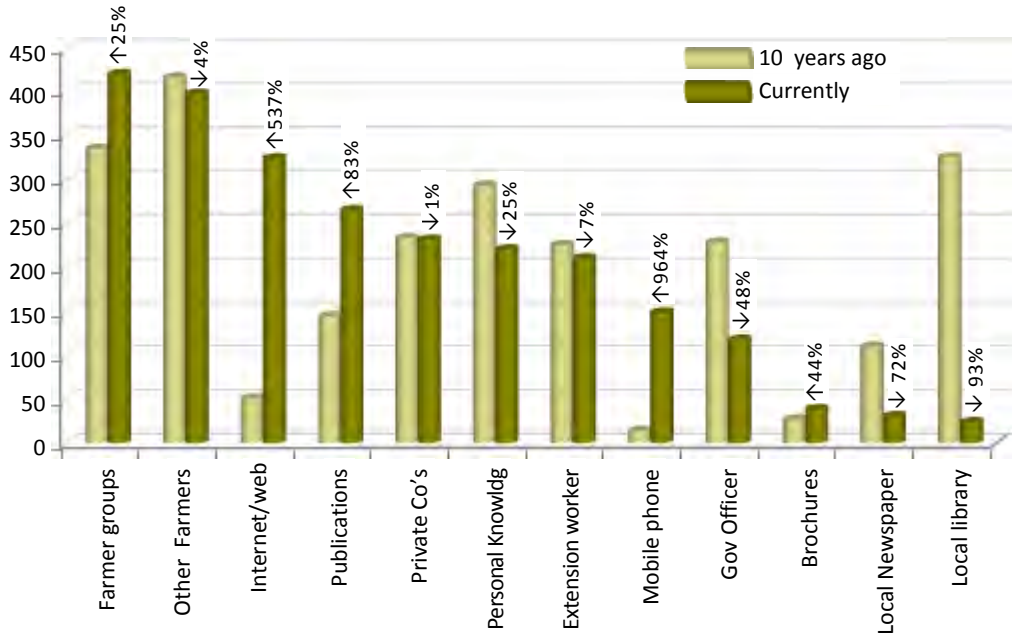

Figure 4.3 Most important info providers for WA farmers over 10 yr period

4.3.3 How have favoured info providers changed over the last decade?

The literature (Marsh & Pannell, 2000; Council of Grain Grower Organisations, 2013; Woodgate & Love, 2012; La Grange, Titterton, Mann, & Haynes, 2009) reports that gradual changes in agriculture over the last 10-15 years has seen government reductions in funding which has led to an increase in the privatisation of agricultural information services. These changes are reflected in the differences in results between Q10 and Q14, which found that the importance of ***Farmer Groups*** – a phenomenon that developed as a result of funding decreases to public sector information provision (Marsh and Pannell, 1998b; La Grange et al., 2009) – has grown by 25% over the last 10 years. The changes are also reflected in the decline in the importance of Extension workers (down 7%) and Government officers (down 48%). The more active involvement of farmers and Farmer groups in the production and provision of agricultural information is also reflected in farmers‘ changing attitudes and understanding of the value of research, which has seen Printed material and Publications increase in importance by 83%.

Over the last 10 years, there have also been major changes in farmers' views that can be explained by the historical changes in Information and Communication Technologies (ICT). Internet/web importance rose 537%; and mobile phone importance rose a staggering 964%, while location specific information sources such as the Local/Community Library has decreased in importance by 93%. The exposure to ever increasing amounts of information and data has also rendered Local Newspapers (down 72%) even less important than they already were 10 years ago (down from ranked 9th to ranked 11th). The change in rankings of information source importance is presented in Table 4.9.

Table 4.9 Most important (ranked) info providers for WA farmers (over 10 years)

Information Source	Characteristics	Current Rank	10 yrs ago Rank	Rank Shift	% Shift
Farmer groups	Intimate/context aware/interactive	1	2	↑ 1	↑ 25%
Other Farmers	Intimate/context aware/interactive	2	1	↓ 1	↓ 4%
Internet/web	ICT/interactive	3	10	↑ 7	↑ 537%
Prints & Publications	Provided/specific	4	8	↑ 4	↑ 83%
Private Co's	Provided/specific/interactive	5	5	same	↓ 1%
Personal Knowledge	Intimate/context aware	6	4	↓ 2	↓ 25%
Extension worker	Provided/coal-face/interactive	7	7	same	↓ 7%
Mobile phone	ICT/interactive	8	12	↑ 4	↑ 964%
Gov Officer	Provided/broad/interactive	9	6	↓ 3	↓ 48%
Brochures	Provided/broad	10	11	↑ 1	↑ 44%
Local Newspaper	Provided/coal-face	11	9	↓ 2	↓ 72%
Local library	Provided/local/	12	3	↓ 9	↓ 93%

The rapid changes in ICT and smart mobile technology has payed a significant part in the recorded changes. According to the Australian Media and Communication Authority's (ACMA) (2012, p. 14) stated that, —mobile services in operation reached 30.2 million, approximately four mobile services for every three people in Australia".

The two most important agricultural information sources for farmers are Farming groups and Other farmers. This has changed only slightly over the last decade, with farmers swapping their neighbours (other farmers) as their most important information source in favour of established Farming groups – which in reality are likely to include those they consider their neighbours and/or other farmers. In this way *Farming groups* and *Other farmers* can be conceptualised as being relatively

similar constructs in the sense that they provide a more intimate and context-aware source of agricultural information for farmers.

4.3.4 Where do farmers get the most accurate information?

Using a traditional Likert scale (Albaum, 1997; Oppenheim, 2000; Ian 2008), farmers were asked which information sources they perceived would provide the most accurate agricultural information. A few participants did not provide an answer for all information sources; therefore, answers to this question have been presented in separate tables showing user responses to each described information source, the number of participants who answered the question, and the value assigned to each result. Table 4.10 presents the weighted formula used to assign this numerical value which allowed the results for individual information sources to be compared and ranked.

Table 4.10 Formula used to obtain a value for information source Likert Scale Q‘s

Q9.1 I get accurate information from **Other Farmers**				
Answer	**#**	**%**	**value**
1 Strongly agree	20	25.6%	=PRODUCT(E3,10)
2 Agree	44	56.4%	=PRODUCT(E4,5)
3 NAoD	14	17.9%	=PRODUCT(E5,0)
4 Disagree	0	0.0%	=PRODUCT(E6,-5)
5 Strongly disagree	0	0.0%	=PRODUCT(E7,-10)
Total	**78**		**5.38**

The formula used to obtain a value for each information source is adapted from Knight and Burns (2011) and weights users ‗strongly agree‘ more heavily than ‗agree‘ by multiplying the percentage results by x10 and x5 respectively. In the same way, ‗strongly disagree‘ and ‗disagree‘ impact the value by having the percentage result multiplied by -10 and -5 respectively. Finally, in this specific case, the ‗neither agree or disagree‘ (NAoD) choice has been given no weighting, and has no impact on the value. Using this formula, the highest value that can be obtained for an information source is 10 – obtained if 100% of users selected ‗strongly agree‘, and the lowest value possible is -10, – obtained if 100% of users selected ‗strongly disagree‘. By imposing this formula onto the user results, a value can be attributed to an information source that takes into account both the positive and negative user perceptions. NB: not all participants answered every Likert Scale question. The ―Total" in the last line of each table is how many answered that question.

Perceived accuracy of Information from Other Farmers & Farming Groups

Eighty two percent of participants asserted that they get accurate information from other farmers (Table 4.11a). Interestingly, none of the participants disagreed with the statement, a result only repeated for the accuracy of information from Farming Groups. Bell (2002) explained that unfamiliar information channels are likely to make farmers reluctant to try or experiment with new methods; but that, farmers are willing to accept new methods from trusted information sources. The implied intimacy, or coal-face, knowledge of ‗other farmers' and its impact on farmers perception of information accuracy is profound, and is repeated even more strongly in participants perceptions of information accuracy from Farmer Groups (Table 4.11b).

Table 4.11a Other farmers (Likert Scale Question 1)

Q9.1 I get accurate information from **Other Farmers**					
	Answer		**#**	**%**	**value**
1	Strongly agree		20	25.6%	2.56
2	Agree		44	56.4%	2.82
3	NAoD		14	17.9%	0.00
4	Disagree		0	0.0%	0.00
5	Strongly disagree		0	0.0%	0.00
		Total	**78**		**5.38**

Rank 2/11

Table 4.11b Farmer groups (Likert Scale Question 5)

Q9.5 I get accurate information from **Farmer groups**					
	Answer		**#**	**%**	**value**
1	Strongly agree		43	55.1%	5.51
2	Agree		34	43.6%	2.18
3	NAoD		1	1.3%	0.00
4	Disagree		0	0.0%	0.00
5	Strongly disagree		0	0.0%	0.00
		Total	**78**		**7.69**

Rank 1/11

Accuracy is described in the literature as one of the ‗intrinsic' (Wang & Strong, 1996; Knight, 2011a) characteristics of information quality (IQ) and has been found to be closely associated with other intrinsic information characteristics such as reliability, credibility and believability. Knight (2011b) found that user perceptions of intrinsic IQ were built on characteristics such as the user having a strong familiarity with the authorship of information, which then has an impact on whether a user feels they can trust information. This is important to the current research because *Other farmers*

(Table 4.11a) and *Farming Groups* (Table 4.11b) are both part of the participants direct personal and/or business networks, and therefore were ranked as a trusted source of agricultural information by 82% and 98.7% of participants.

The agreement (82%) that *Other farmers* are a source of accurate information reflects the inherent trust that comes with the knowledge and familiarity of the information‘s authorship. The collective familiarity of specific farming communities and/or practices, particularly if those involved have common goals, is reflected in the even higher association of *Farming groups* (98.7%) with accurate information. This result is consistent with previous research with found that Grower groups (called Farming groups in this research) and their networks are effective research partners and considered to be valuable resources for implementing the outcomes of research (Gianatti & Carmody, 2007). It has been documented that grower groups are very successful in trialling and promoting strong research-based technology (Ridley, 2005). Many tasks are performed by Grower groups in rural areas, including recognition of locally raised issues to be investigated, knowledge sharing between members allowing social interaction, and the provision of feedback to researchers on new innovations and technologies (Gianatti & Carmody, 2007). The current research suggests it is the familiarity and close-knit qualities of *Farming groups* that makes them effective in the above ways because they establish the intrinsic characteristics of IQ. Establishing intrinsic IQ is known to improve users‘ perceptions of information accuracy, reliability, credibility and believability (Knight, 2011a, 2011b) and is central to the user trusting the information encountered. The relative intimacy of both the Other farmers and Farming groups channels helps to establish this high degree of trust, and is shown in the research results regarding farmers perception of the accuracy (90.4% agree or strongly agree) of these information sources which – using the weighted formula (see Table 4.9) were ranked second and first (see Table 4.11a & 4.11b) for accurate information by the farmer participants.

Perceived accuracy of Information from Purposed Services

Agricultural Information services are purposed services designed to disseminate relevant information into and within farming communities. Generally described in

terms of agricultural extension, the information agents within this type of system include Extension workers, Government officers and Private consultants.

In recent years, as explained by La Grange et al. (2009), public funding of extension has been reduced and extension funding is increasingly sourced from farmers' levies and other private agencies. Moreover, public sector and other funding bodies require that extension programs demonstrate efficiency and lead to farming practice changes. What's more, there is a lack of skilled farm staff adding a new challenge to farmers who now need to manage and train people. As explained by La Grange, et al. (2009, p.5), —this has led to a new direction for extension services where training and education of farm managers and workers in farming management practices and in human resource management is increasingly important in the sphere of funded extension activities". In the context of this changing information/extension landscape, questions 9.3, 9.4 and 9.6 were designed to capture something farmers perceptions of the accuracy of the various agricultural extension models.

Table 4.11a shows that the number of participants who perceive that extension workers give them accurate information is relatively high (79.2%). Traditionally, agricultural extension has been characterised by the public sector, with the state Department of Agriculture as the major provider of agricultural extension services (Marsh & Pannell, 2000). However, in the last 10-15 years due to the government reduction of its funding to the departments of agriculture, extension worker numbers has declined and been replaced by an increasing number of private agriculture consultants (Watson, 1996; Woodgate & Love, 2012).

Table 4.12a Extension workers information

Q9.3 I get accurate information from **Extension workers**				
Answer	**#**	**%**	**Value**	
1 Strongly Agree	13	18.1%	1.81	
2 Agree	44	61.1%	3.06	
3 NAoD	14	19.4%	0.00	
4 Disagree	1	1.4%	-0.07	
5 Strongly Disagree	0	0.0%	0.00	
Total	**72**		**4.80**	**Rank 3**/11

Private consultants (Table 4.11b) did not enjoy the same high perception of accuracy as agricultural Extension workers. While 64% of participants see private companies as a relatively trusted source of agricultural information, this was the lowest of the purposed agricultural information services, with Extension workers (79.2%) and Government officers (72%) both rating better. In addition, the weighting formula ranked Private agricultural consultants 7th out of 11, while ranking Extension works (3rd) and Government officers (5th).

Table 4.12b Private companies

Q9.4 I get accurate information from **Private companies/consultants**						
	Answer		**#**	**%**	**value**	
1	Strongly Agree		11	14.7%	1.47	
2	Agree		37	49.3%	2.47	
3	NAoD		26	34.7%	0.00	
4	Disagree		1	1.3%	-0.07	
5	Strongly Disagree		0	0.0%	0.00	
		Total	**75**		**3.87**	**Rank 7**/11

Tarnoczi and Berkes (2010) reported that industries frequently offered information related to their products by their own extension workers; this may be a reason as to why participants ranked private companies as less credible. The results from this study are consistent with Banmeke and Ajayi's (2007) findings, who reported commercial agents (ranked 8th out of 9) were ranked below Extension agents (1st out of 9) for information sources utilised by Nigerian women farmers.

Table 4.11c shows that Government officers ranked higher than Private consultancy as trusted source of agricultural information, with nearly three quarters (73.9%) of participants agreeing they get accurate information from this type of agent. It Is not clear if this question was clear enough to participants as it may be seen as they were asked about an _extension worker' or farmers seen it somewhat meant the same in the context of the question. Extension workers are facilitators disseminating agricultural information and technologies to improve agriculture on the field (Vanclay, 2004) and therefore a Government officer can be an Extension worker. In the context of this research then, a government officer is a government body worker who works in the agriculture department or similar, regardless of whether the information service

they provide is specifically considered to be agricultural extension or not. The question was designed to gather data about government departments' effectiveness from the perspective of farmers, and to see if they still play any role in agriculture information dissemination. In this way, it implies an interesting finding regarding agricultural information services and extension. It appears that Extension, when provided by a commercial or private company is perceived to be less accurate (64% agree) than when provided by a government agent (74%).

Table 4.12c Government officers

Q9.6 I get accurate information from **Government officers**						
	Answer		**#**	**%**	**value**	
1	Strongly Agree		9	12.3%	1.23	
2	Agree		45	61.6%	3.08	
3	NAoD		18	24.7%	0.00	
4	Disagree		0	0.0%	0.00	
5	Strongly Disagree		1	1.4%	-0.14	
		Total	**73**		**4.17**	**Rank 5**/11

Perceived accuracy of ICT (Internet & Mobile) delivered Information

Table 4.12a shows 81.3% of participants believe that the Internet and Web provide accurate agricultural information.

Table 4.13a Internet/Web

Q9.8 I get accurate information from the Internet/Web						
	Answer		**#**	**%**	**value**	
1	Strongly Agree		12	16.0%	1.60	
2	Agree		49	65.3%	3.27	
3	NAoD		13	17.3%	0.00	
4	Disagree		0	0.0%	0.00	
5	Strongly Disagree		1	1.3%	-0.13	
		Total	**75**		**4.74**	**Rank 4**/11

Table 4.12b shows that 52% of participants believe that they get accurate information from their mobile phones. The ICT results, however, may be compromised by the increased blurring of the boundaries around the concept of the original Internet/Web, that required users to operate a modem and physically log-on, and current mobile technologies, with seamless integration and use of wireless Internet infrastructure providing Internet connectivity 24/7. In addition, users' perception of ICT-driven information can be impacted by the mode-of-delivery and connectivity as much as by the perceptions of the actual information being delivered.

Table 4.13b Mobile phone

Q9.9 I get accurate information from my **Mobile phone**					
	Answer		**#**	**%**	**value**
1	Strongly Agree		5	6.7%	0.67
2	Agree		34	45.3%	2.27
3	NAoD		27	36.0%	0.00
4	Disagree		7	9.3%	-0.47
5	Strongly Disagree		2	2.7%	-0.27
		Total	**75**		**2.20**

Rank 9/11

The reason that Mobile ranked low is due to the fact that the majority of rural WA experience poor telecommunication service and the mobile service coverage is inadequate (Sinclair, 2012). Surveyed farmers in this study stated that their biggest problem was the Internet speed and the mobile service coverage.

Perceived accuracy of Information in the Broad Media

Table 4.13a shows that 68.4% of participants considered the Rural press to be a relatively accurate source of information. This is a clear indication that some printed materials still play an important part of agricultural information delivery. The qualitative data collected as part of the interaction with farmers, suggested that printed media could be taken with farmers into the field and could be sighted any time, when they have a break or when they are driving their machineries.

Table 4.14a Rural press

Q9.1 I get accurate information from Other Farmers					
	Answer		**#**	**%**	**value**
1	Strongly Agree		11	14.5%	1.45
2	Agree		41	53.9%	2.70
3	NAoD		23	30.3%	0.00
4	Disagree		1	1.3%	-0.07
5	Strongly Disagree		0	0.0%	0.00
		Total	**76**		**4.08**

Rank 6/11

This result is nevertheless curious in light of how farmers ranked Newsprint/media 11th (out of 12) for their preferred mode of information delivery (see Figure 4.3 in previous section) and therefore suggests that ‗accuracy' is not the only dimension of information quality that farmers use when deciding which information channels to engage.

Table 4.13b shows that 56.2% of participants agreed that the Radio was an accurate source of information. Significantly, the Strongly agreed numbers were very low at

5.5%, and the low weighted ranking (8th out of 11 delivery channels) supports Locke's (2005) research findings that Radio has come to play a more supporting – rather than a primary – role in agricultural information delivery. In Locke (2005) research only 7.4% of New Zealand farmers used radio.

Table 4.14b Radio

Q9.7 I get accurate information from the **Radio**					
	Answer		**#**	**%**	**value**
1	Strongly Agree		4	5.5%	0.55
2	Agree		37	50.7%	2.54
3	NAoD		28	38.4%	0.00
4	Disagree		4	5.5%	-0.28
5	Strongly Disagree		0	0.0%	0.00
		Total	**73**		**2.81**

Rank 8/11

Table 4.14c shows that 30.6% of participants still consider the TV to be an accurate source of information. In terms of television, participants in this study felt it to have played some supporting role. This is inconsistent with Locke (2005) who found that only 4.3% of New Zealand farmers were regularly using television as an information source.

Table 4.14c TV

Q9.11 I get accurate information from the **TV**					
	Answer		**#**	**%**	**value**
1	Strongly Agree		1	1.4%	0.14
2	Agree		21	29.2%	1.46
3	NAoD		43	59.7%	0.00
4	Disagree		7	9.7%	-0.49
5	Strongly Disagree		0	0.0%	0.00
		Total	**72**		**1.12**

Rank 10/11

It is true to state from this study that television and radio only play a supplementary role to other sources of information for WA farmers, which is in line with Tarnoczi and Berkes' (2010) findings regarding Canadian farmers, and Locke's (2005) findings of New Zealand farmers.

On the other hand, Murugan & Balasubramani's (2011) research into the information seeking behaviour of Tapioca (Cassava) farmers in Indian found that 73.5% of participants rated radio and 63.2% of participants rated television to be significant sources of agricultural information. Moreover, Arumapperuma (2008) asserted that

radio was a major communication channel used in his study of Sri Lankan farmers, although television was rarely used. Similarly, television did not play any role in Field et al.'s (2007) American based study

Perceived accuracy of information from a Community/Local library

Table 4.14 presents the disparate views of participants regarding the capacity of a local library to deliver accurate agricultural information. Over a third (37%) of participants disagreed (including 17% strongly disagreed) that a farmer could expect to obtain accurate information from a local community library. This may relate to the development in the ICT, as the library is seeing more as an internment centre rather than an information provider (Partridge, 1991).

Comparing and Ranking the Perceived Accuracy of Information Channels

Table 4.15 shows the collective results to question 9 grouping them conceptually into similar types of agricultural information delivery channels. For example; Radio, rural press and TV are all conceptualised as broad media, while Other farmers and Farming groups are conceptualised as being part of each farmer's built personal or business network. It is interesting to cluster types of delivery in this way because it can sometimes reveal why user results vary. For example, if broad media is considered a 'push' information channel, while farmer's built networks –personal or business – are considered a 'pull' information channel, (Csótó, 2011; Black, 2000), then understanding how push and pull information channels and technologies differ can shed additional light on why farmers value Other farmers and Farmer groups so much more than television or radio when it comes to their perceptions of where they can retrieve accurate information.

Table 4.15 Local library

Q9.2 I get accurate information from My **local library**					
	Answer	**#**	**%**	**value**	
1	Strongly Agree	1	1.4%	0.14	
2	Agree	9	12.9%	0.65	
3	NAoD	27	38.6%	0.00	
4	Disagree	21	30.0%	-1.50	
5	Strongly Disagree	12	17.1%	-1.71	
	Total	**70**	**Total**	**-2.43**	**Rank 11**/11

Table 4.16 Clustered results of famers perceptions of accuracy of info channels

					Total SAorA		Total NAoD				Total DorSD			
#	Answer	Delivery Type (concept)	SA	A	#	%	#	%	D	SD	#	%	#	DNA
1	Other farmers	Networks: personal	20	44	64	**82.1**	14	**17.9**	0	0	0	**0.0**	78	1
5	Farmer groups	Networks: person/bus	43	34	77	**98.7**	1	**1.3**	0	0	0	**0.0**	78	1
		Intimate networks				***90.4***		***9.6***				***0.0***		
3	Extension workers	Info/extension service	13	44	57	**79.2**	14	**19.4**	1	0	1	**1.4**	72	7
4	Private companies	Info/extension service	11	37	48	**64.0**	26	**34.7**	1	0	1	**1.3**	75	4
6	Gov officers	Info/extension service	9	45	54	**74.0**	18	**24.7**	0	1	1	**1.4**	73	6
		Purposed Services				***72.4***		***26.3***				***1.4***		
8	Internet/Web	Indiv: connectivity	12	49	61	**81.3**	13	**17.3**	0	1	1	**1.3**	75	4
9	Mobile phone	Indiv: connectivity	5	34	39	**52.0**	27	**36.0**	7	2	9	**12.0**	75	4
		Connectivity				***66.7***		***26.7***				***6.7***		
7	Radio	broad Media	4	37	41	**56.2**	28	**38.4**	4	0	4	**5.5**	73	6
10	Rural press	broad Media	11	41	52	**68.4**	23	**30.3**	1	0	1	**1.3**	76	3
11	TV	broad Media	1	21	22	**30.6**	43	**59.7**	7	0	7	**9.7**	72	7
		Broad Media				***51.7***		***42.8***				***5.5***		
2	Local Library	Physical space	1	9	10	**14.3**	27	**38.6**	21	12	33	**47.1**	72	7
		Physical Community Space				***14.3***		***38.6***				***47.1***		

Table 4.16 presents the ranked perceptions of West Australian farmers in terms of where they expect to find accurate agricultural information. The scores used to rank delivery channels were calculated using the weighting formula shown in Table 4.9.

Table 4.17 Farmers perceptions of accurate information channels (ranked)

Q9: The most accurate information comes from:		
Rank	Information channel	Score
1	Farmer groups	**7.69**
2	Other Farmers	**5.38**
3	Extension workers	**4.80**
4	Internet/Web	**4.74**
5	Government officers	**4.17**
6	Rural press	**4.08**
7	Private consultants	**3.87**
8	Radio	**2.81**
9	Mobile phone	**2.20**
10	TV	**1.12**
11	local library	**-2.43**

4.3.5 Agricultural Information service organisations

A number of organizations produce and deliver learning resources to rural communities throughout Australia. These include farmer based organizations,

agricultural consultants, government agencies and industry research agencies. Participants were asked about their interaction with such organisations

Table 4.18 Organisation used by WA farmers

Q12. Organisations used by Farmers in WA				
	Organisation	Org Type	#	%
1	DAFWA	Gov	70	89%
5	GRDC	Gov	58	73%
2	WANTFA	Prv & Gov	37	47%
7	Liebe Grp	Prv & Gov	37	47%
9	Kondinin Grp	Prv & Gov	30	38%
8	Mingenew-Irwin	Prv & Gov	9	11%
6	GGA	Prv	37	47%
4	AAAC	Prv	22	28%
3	SEPWA	Prv	18	23%
10	Other		14	18%
		Total	79	

***DAFWA**: Department of Agriculture and Food, Western Australia. State Government organisation focusing on export growth working with agribusiness to produce high quality food within the WA Agricultural industry*

***GRDC**: The Grains Research and Development Corporation. Government organisation established nationally in 1990. Aims is to benefit grain growers and the Australian Government through investing in research. Publications such as fact sheets of technical research and other agricultural-related information. Produces Ground Cover Magazine and a related radio program.*

***WANTFA**: Western Australian No-Tillage Farmers Association. Farmer owned and driven group which has over 800 national and international members. Aims to promote the connection between growers and scientists to get the best outcomes. Funded and supported by the GRDC, Australian Government Department of Agriculture, Fisheries and Forestry, corporate sponsors, events income and membership fees.*

***Liebe Group**: A not for profit farmer driven organisation in the WA Wheat-belt region. Conducts research & development and provides information to 120 farm business members in the Dalwallinu, Coorow, Perenjori and Wongan Ballidu Shires.*

***Kondinin Group**: Established in 1955 in WA Wheat-belt. Assists farmers in their decision making by providing them with practical, independent agricultural*

information. Flagship publication Farming Ahead, membership and information services, publishing, training and consultancy services

***Mingenew-Irwin**: Established in 1994 in the shires of Mingenew and Irwin. Focuses on research, information provision to its members, and education. Employs 7 staff and 2 agricultural consultants*

***GGA**: Grower Group Alliance. Non-profit, farmer driven organisation connecting grower groups, research organisations and agribusiness in a network across WA. Developed by grower groups in 2002 and is managed by an advisory committee and funded by the GRDC*

***AAAC**: Australian Association of Agricultural Consultants. Private organisation that provides its members with professional support services, training, regular seminars and conferences. Members with AAAC must also retain membership of the Australian Institute of Agricultural Science and Technology" (AIAST)*

***SEPWA**: South East Premium Wheat Growers Association. Established in 1993 and considered to be the largest farming groups within WA. Produces information to its members inc, e-news, and annual Trial Results booklet*

As shown from Table 4.17 DAFWA was selected by the majority of farmers 89%, followed by the GRDC 73%. However, it is interesting to note that, during the interaction with farmers, for the former organisation, farmers stated that they used to call when they require information, but due to the staff shortage at DAFWA, they stopped doing that. Moreover, farmers expressed their disappointment with both organisation websites, claiming that they are hard to follow and they contain an overwhelming amount of information

4.4 Types of Information Farmers need

4.4.1 What kind of information do farmers require

Farmers need relevant agricultural information to help them improve their productivity. Therefore, it was important to highlight the agricultural information type that is required by farmers from their perspective. Table 4.18 presents the agricultural information needs of the study's participants. Farmers were asked "What kind of information do you require?", participants were given multiple choices to choose from

and could choose more than one answer, including (other) if they wished to add something that was not listed.

The vast majority of farmers (94%) stated they required information about the weather forecast, followed by cropping/varieties (89%) and fertiliser management (86%). This is not surprising, since the majority of participants (73%) are engaged in mixed farming activities. Market prices, and disease and pest control (each 78%), and farm sustainability (75%) were also identified as needed information. Financial advice and education/health information were the least required information (62% and 56%, respectively). Almost half of the survey participants (44%) indicated that they needed all of the types of agricultural information listed.

It is thought that farmers look for information when they are faced with a specific issue on their farms. Therefore, the type of information importance and requirements are based on the farmer‘s need of specific information at particular time. For example, if the farmer faced with pest infection in his crop he would seek information regarding pest management type of information.

Table 4.19 Type of agricultural information requirements of participants

Q10. What kind of information do farmers need				
	Type of Information		**#**	**%**
3	Weather forecast		75	95%
1	Cropping/varieties		71	90%
2	Fertilizer management		70	89%
7	Market prices		64	81%
6	Disease and pest control		62	78%
4	Farm sustainability		61	77%
8	Financial advice		51	65%
5	Education/health info		45	57%
		Total	**79**	

Note: multiple responses possible

4.5 The Qualitative Data

Four of the final six questions in the survey were ‗open ended‘ questions. That is, farmers were asked a question which they could answer in their own words. Farmers answers to questions #13, #15, #16 and #17 were put into a their own table and then examined for emerging themes. This was done as follows: (1) the farmer‘s answer

was placed in column #1; (2) column #2 contains the researcher‘s own words to describe what each farmer stated in column #1; (3) columns #3 and 4 contain words which described emerging themes in the form of technologies used or behaviour changes; (4) columns #5, 6, and 7 contain key concepts from previous research in information retrieval (IR), information seeking behaviour (ISB) or information quality (IQ) that the themes and behaviours identified in previous columns fit into. Each table was then examined in order to produce the following discussions of results. An example of the qualitative analysis process was presented in Table 3.19. Whole tables of analysis are included as Appendix D.

4.5.1 Changes to the information resources used in the past 10 years

*Q13. Information delivery has changed great deal in the **last 10 years**, how has that effected the ways in which you gather information?*

Farmers were asked an open ended question to explore the changes that have accrued over the last 10 years to information gathering. Out of the 79 participants, 73 responded to this question, the views that were highlighted regarding the changes that occurred in relation to information channels used by participants in the last 10 years are shown in Appendix D1. Themes that emerged are: (1) an increase in ICT usage and reliance through improved connectivity – particularly in mobile ICT; (2) improvements in the currency (up-to-date), relevancy and accessibility of/to agricultural information. The increase in the amount of agricultural information available has led to farmers‘ feeling a greater independence in selecting the relevant information although the issue of the overload amount of agricultural information is a two sided coin; some farmers see this as a good thing, whiles others see it as a confusing, conflicting and hard to consume.

The last decade has also seen a shift towards more reliance on Grower groups as trustworthy channels of information; this is in line with the survey answers. Grower groups came about when the government began to decrease levels of funding to the public sector (more information about the history of these groups can be found in 1.1.3 Chapter One). The intimacy of these grower groups, which form around farmers‘ common crop-production, business supply chains and geographic location

provide an information environment for farmers that improves perceptions of the relevancy and applicability of the information exchanged.

4.5.2 Difficulties farmers encounter when accessing required information

16. What difficulties do you encounter when accessing required information?

Participants were asked about the difficulties they have with the new ICTs when accessing required information, 61 out of the 79 participants in the study answered this question. Themes that emerged are shown in Appendix D.2, these were, the poor connectivity in rural and regional areas and the lack of ICT infrastructure, the large amount of agricultural information available which led to conflicting information and difficulties in finding relevant information to local farming conditions. Participants who complained about Internet speed and mobile coverage were predominantly from Wheat-belt towns such as Kelleberrin, Dalwallinu and Corrigin, as well as from the Goldfields, whereas participants located in Greenough, Perenjori, Cambridge and Koorda, had fewer problems accessing information. In general, the main issues encountered by farmers in WA were, accessibility – in an infrastructure sense; and having to determine ICT-driven agricultural information relevancy to local WA conditions. Specifically, participants acknowledged the following difficulties when accessing required agricultural information: the overwhelming amount of information available, slow Internet speed, deficiencies in mobile coverage, lack-of relevance of information to WA farming conditions, perceived unreliable information sources and, finally, the generalisation of information – i.e., perceptions that ICT-enabled information was —nt odirect enough".

As a largely self-resourcing occupation, farmers are often required to find relevant information for themselves. The majority of farmers indicated that their major difficulty when accessing agricultural information was the overwhelming amount of information available and the lack of time to sift through found information. A lack of time is a general issue facing many farmers. In 2010–2011, farmers worked on average 49 hours per week compared to 36 hours of the employed population (ABS, 2012).

4.5.3 Future requirement for effective information delivery

15. If you were able to decide how information should be most effectively delivered in the future; what would you suggest is required?

Farmers were asked how information should be most effectively delivered in the future and what was the requirement for doing that, and 61 out of the 79 participants in the study answered this question, analyses are shown in Appendix D.3. Themes that emerged were the increased use of particularly mobile ICT and the need for better ICT infrastructure to support this. Better search engines were requested, which would help farmers deal with a major issue identified in Q16 and Q13 of the sheer overwhelming amount of information available from the Internet. Farmers also expressed that they still require face to face communication; as having experienced people from relevant agricultural organisation on the ground (farm) to give advice and introduce new innovations, and more support to Grower groups. A theme that emerged was that the design of agricultural information delivery processes required a bottom up approach; this approach seeks the cooperation between the information providers (researchers) and farmers. This was consistent with Black (2000); Csótó (2011); and Dey, Prendergast, & Newman‘s (2008) findings that bottom up approach is better than top down, as the earlier is targeting information needs from the prospective of the end user. The growing and use of number of farmer groups is one such bottom-up approach to information dissemination and retrieval.

4.5.4 Improvement of agricultural information dissemination from the perspective of farmers

17. In your opinion, what can be done to improve agricultural information delivery methods to use in your decision making?

Farmers were asked about how agricultural information dissemination could be improved with 52 out of the 79 participants answering this question. Appendix D.4 shows the themes that emerged from farmers‘ answers. These include: bottom-up approach, improved ways to search and retrieve data, increase independence and information relevancy to local farmers, improve ICT infrastructure, and increase support for local networks

CHAPTER 5 DISCUSSION: Implications & Application

5.1 Introduction

This chapter revisits the results presented and briefly discussed in Chapter 4 to discuss the Research Questions of the thesis.

5.2 Research Questions

The research questions associated with this thesis are as follows

RQ 1. How can ICTs applications/technology devices and supporting infrastructure be used to support WA farmers‘ decision making?

RQ 1a What types of information do WA farmers need/retrieve?

RQ 1b What are the preferred modes of farmers‘ information retrieval?

RQ 1c How have preferred modes of information retrieval changed over the past 10 years?

RQ 1d How can agricultural information delivery and retrieval be improved using ICTs?

5.3 DISCUSSION-INFORMATTION RETRIEVAL IN WA AGRICULTRE

In this section all results will be summarised to answer the research questions presented in Section 1.5 of Chapter 1. The four sub-questions of research question 1 will be answered; subsequently, research question 1.

5.3.1 What types of information do WA farmers need/retrieve (RQ 1a)?

Farmers tend to acquire information relevant to them; concerning issues on their local areas and farms. It was revealed that farmers look for information when they are faced with an issue on their farms. It was also found that farmers looked for information that is relevant to their local/geographic environment as they perceived what works in other countries or even other regions may not necessarily work for them. According to the survey findings, the most frequently needed topics of information by farmers are information related to the weather forecast, cropping and varieties, fertiliser management, and product market prices. Information related to disease and pest control, farm sustainability, financial advice, and education and health information was requested by the majority of farmers.

Hill (2009) asserted that information seeking behaviour is affected by the type of information sought and the stage in a farmer‘s decision-making process and that as the process of decision-making reaches its final stages the information sought becomes very specific. The specificity being referred to here relates to *information relevancy* and is referred to by Knight (2011a) as an important part of a user‘s perception of contextual Information Quality (IQ).

WA farmers stated how frustrated they were with the large amount of information they receive through electronic and non electronic means, explaining that they do not have time to sit down in front of the computer to weed through and sort what was legitimate information and what was not, nor do they have time to sit all day reading articles about new innovations that might work for WA farming conditions or might not. The perceived relevancy of information was therefore considered an important precursor for whether farmers chose to take the time to ingest that information. However, farmers stated that the overwhelming amount of information available made it difficult for them to select, retrieve and follow up with new agricultural innovations suitable for WA farming conditions. They suggested they would like to have concise, relevant and timely agricultural information, as well as in a known format to them. Farmers emphasised that they need to be given the chance to ask for the information (bottom up) they really need and want instead of being sent all types of agricultural information by information providers that is not needed or wanted. This is consistent with one of themes that emerged from the open ended questions showing that some farmers see the overwhelming amounts of information available to them is actually a good thing as this have given them independency and provided them with more information to select from. This is also consistent with previous research into user perceptions of information quality (Knight, 2011a & 2011b) that contextual-IQ – including perceptions of information currency, relevancy and scope/depth (amount) – are used by information retrievers, in this case farmers, to make judgements about their own capacity to interact with and apply the information they encounter, rather than to make negative judgements about the actual content of information. This is both a good and bad thing. It firstly means that the large amount of information made available to farmers by today‘s ICTs does not necessarily

negatively impact their perceptions of the usefulness and potential accuracy of the information/systems available, but according to Knight's (2008, 2011a & 2011b) research into users perceptions of IQ during the information life-cycle (i.e., production/retrieval), it can impact farmers willingness to engage those ICTs because at the contextual stage of the information life-cycle farmers are judging their own cognitive ability to find relevant information as much as the information itself. Negative information interactions at this point in information retrieval can therefore have an impact on users self-efficacy to interact effectively with the ICT delivering the data/information, so information providers need to find ways to help farmers better sift-through the non-relevance.

This research suggests that farmers do not have time, and they look for information that concerns certain issues on their farms, so providing them with information that is not required at the time can waste both farmers' and information providers' time, and ultimately make farmers less willing to engage new ICTs. The time-poor characteristic of farmers information interactions was also observed by Doole, Bathgate and Roberston (2009), and Woodgate and Love (2011) who found that farmers complained about the large amount of available agricultural information, the relevancy of information to WA farming conditions, and ICT infrastructure.

According to Siddiqui (2011, p. 55), "The increase in information available on the Web has affected information seeking behaviour" and that impact – for a time-poor occupation like farming – is likely to be in the area of negatively impacting perceptions of information scope and relevancy. The general results of this research are consistent with this, with farmers' indicating that due to the overload of information available on the net, they lose interest, so they use an easier option, such as using the telephone and calling someone to get the right answer.

Elsey and Sirichoti (2003) asserted that farmers may change their attitude towards the use of ICT tools when they realise the benefits (relative advantage) derived from their usage. This research found that farmers already see the potential information benefits of engaging ICTs, however the sheer amount of information available has the potential to lessen these perceptions of the benefits because when it comes to

what types of information WA farmers retrieve, they retrieve highly specific information relevant to the task at hand. This, compounded by farmers' time-poor occupation, means the large amount and scope of information available via ICTs has the potential to disengage farmers from ICT use as part of their farming decision-making and processes. Therefore, agricultural ICT developers and information providers need to consider developing specific ICTs, designed for specific farming tasks, using smaller – but much more specific – datasets in order to effectively support farmers' agricultural processes.

5.3.2 What are the preferred modes of farmers' information retrieval (RQ 1b)

It has been found by this study that ***WA farmers acquire information through channels known, or familiar, to them***. This is consistent with Elsey and Sirichoti's (2003) and Karnka's (2006) studies which asserted that success of innovation depends on the information channels used and how familiar those channels were to farmers are important factors for adopting new knowledge. The farmers in this study were presented with a list of 12 common agricultural information distribution channels and ranked these according to their importance. The top two information channels ranked by farmers were: (1) farmer groups; and (2) other farmers. Farmers' grower groups are community based groups which grow as a result of local and/or regional issues in agricultural production. In this sense, they fall into the defining classification of —Communities of Practice" (COP), however the informal information relationships formed with other farmers can also be considered a COP (Wenger, 1998).

This study also found that farmers' preferred information channels are subject to change over time, although a strong familiarity with an information channel remains the primary driver regarding each channel's importance. For example the top two information channel 10 years ago were still: (1) other farmers; and (2) farmer groups, but there were shifts in other preferred channels, driven by changes in ICT, business practices and farming culture. Regarding the use of a local library as a source of information, this study found that the library no longer plays any important role, down 93% as a ranked information source from 10 years ago.

The greatest shift in farmers‘ preferred information delivery channels over the last 10 years has been in ICT supported information exchange. Today, the third most important information delivery channel to WA farmers is the Internet, up from 10th a decade ago (rise in importance-score of 537%). The greatest increase from a baseline score of 14 (and ranked 12th) has been the importance of the mobile phone, up 964% from its score a decade ago.

Mobile technology, computers and Internet connectivity have the potential to deliver the information to a wider audience and in timely manner (Dey, et al., 2008). However, it has been reported that a lack of ICT capabilities understanding has hindered the adoption of new technologies in an agricultural setting (Warren, 2004). In countries such as New Zealand ICTs infrastructure difficulties have caused delays in the adoption of ICTs by farmers in rural areas (Shiblaq & Fielden, 2008). Moreover, it has been reported that education level can be an influencing factor for farmers reluctance to adopt ICTs (Sindir, 2005).

For WA farmers, this study revealed that they know the advantages of the ICT, and are capable of using such technology. However, they lack the adequate infrastructure and connectivity. Mobile telephone has been an increasingly important part of the Australian communication environment since the 1990s, and the introduction in late 2007 of new generation smart-phones and the tablets such as the iPad in 2010 has revolutionised mobile phone design and use (ACMA, 2012). With their many features, modern ICTs have the capability to seamlessly access the Internet from almost anywhere, and they are relatively affordable. Therefore, time and place are no longer an issue when looking for information via electronic channels. Studies such as Mangstl (2008) claimed that, mobile technology is the most successful ICT tool used to develop worldwide agriculture sector. This was echoed by Munyua, Adera and Jensen (2008) asserting that mobile communication technologies in many parts of the world have become important factor in improving agricultural information delivery.

In terms of the broad media – including Television, Radio and Newspapers, participant responses to survey Question 8 revealed that around half (49.4%) of the farmers identified they used radio, and a quarter (26.6%) used television to receive

information. However, when asked to rate the accuracy of information encountered (Question 9) the Likert scales revealed that the Rural Press, Radio, and TV ranked 6th, 8th and 10th out of 11 listed information channels. As such it is true to state from this study that television and radio only play a supplementary role to other sources of information, which is consistent with Tarnoczi and Berkes' (2010) findings. This is in contrast to the _developing world' where mobile services are still becoming established According to Murugan and Balasubramani's (2011) study, 73.5% of Cassava growers in Salem (India) rated the radio to be a significant agricultural information source, and television was rated at 63.2%. Moreover, Arumapperuma (2008) asserted that among the major communication channels used by the Sri Lankan farmers in his study were radio and television although when asked how often these channels were engaged, television was rarely used. Consistent with the developed world context of the current study, Field et al.'s (2007) study of Information Dissemination in the American Beef Cattle Industry found that television did not play an important role, and Locke (2005) who surveyed television and radio's supporting role as agricultural information sources in New Zealand found that only 7.4%. of farmers were using radio and even less (4.3%) were using television.

The WA farmers who took part in this research indicated that they prefer to retrieve information from known/familiar information channels. This should be taken into account in government, and non-government, agricultural information dissemination policies and procedures.

5.3.3 How have preferred modes of information retrieval changed over the past 10 years? (RQ 1c)

Rapid changes have occurred in the last 10–15 years in relation to information delivery mechanisms. One such change that has influenced information delivery to agricultural stakeholders is the reduction of government funding to the public sector, which resulted in the rise of the private sector agricultural consultation and the creation of farmer groups. This being said, the public sector still plays an important role but this role is gradually diminishing. The other important change that has influenced information dissemination is the rapid development of ICTs. This study

found that channels of information have changed and these changes have put pressure on farmers to acquire timely information so that their businesses can survive and stay profitable. The changes in the information behaviours of farmers to utilise available ICTs has led to a call for the government to improve ICT-supporting infrastructure to rural areas in WA, as well as the rest of rural, regional and remote Australia. This resulted in the undertaking of the largest federal infrastructure project ever committed to, the National Broadband Network (NBN), which was announced in 2009. How the change of Australian federal government in 2013 will impact this project is yet to be seen.

It was this research finding that farmers tend to rely on farmer groups more than they used to 10 years ago. Farmers also stated that they have more information available to them on a variety of channels especially on ICT to choose from; which some farmers see the overwhelming of information available is actually a good thing as this have given them independency and provided them with more information to select from. Other farmers see that as a challenge as that made it hard for them to find relevant information to their needs. The development of mobile technologies and smart-phones can facilitate the use-of and reliance on farming groups by improving local/people connectivity.

The above discussion to sub research questions (1.1, 1.2 and 1.3) has revealed that the use of ICT in rural WA will better serve farmers information needs as the majority of respondents supported the idea that ICT has great prospects as a dissemination and retrieval channel. However, few considered the idea of ICT replacing the existing information delivery methods; hence, consideration was given to having information delivered through known channels to farmers, and to not ignoring printed forms. From the results gained from the survey, and interaction with farmers, it was clear that multiple factors need to be considered in order to improve the agricultural information dissemination in WA.

5.4 DISCUSSION-IMPLICATIONS

5.4.1 How can agricultural information delivery and retrieval be improved using ICTs? (RQ 1d)

The development in ICTs is driving economic and social changes. The digital media and communication such as the Internet and the mobile smart-phone are the leaders of that growth (ACMA, 2008a). The usage of ICT has become entrenched in the Australian economy and the social structure in our society. It has been reported that, for the majority of Australians, the Internet usage became an everyday experience **(**ACMA, 2008c).

Build ICTs using a Bottom-up Approach

From the perspective of agricultural information providers, the application of ICT-enabled information delivery should begin with a clear development strategy identifying the target – i.e., farmers. The results in this study suggest that a bottom-up approach involving farmers in the process of information design and delivery is likely to be better than a top-down approach, especially since WA farmers like information to be specific for their needs and familiar in format and delivery channel. A bottom-up approach to information systems design is generated by the need of farmers rather than the need of information providers (Dey, Prendergast, & Newman, 2008). How to address some of the variable factors found by this research to impact farmer‘s ICT and information use such as gender, age, level of education, the inadequate ICT infrastructure (especially in rural WA), and the large amount of information available—can be better taken into account by agricultural information vendors and policy makers when they engage this bottom-up approach.

Taking into consideration farmers‘ information needs, farmers expressed their need for concise, relevant and timely agricultural information. Instead of information providers guessing what type of information farmers need and in which format, and/or assuming that every farmer likes to search the net for relevant information and has the time to do so, it is recommended that farmers be consulted about what information they need, when they need it and, most importunately, in which format.

Develop Infrastructure to support Mobile ICT

From the results gained from the survey, from the interaction with farmers, it was clear that some factors need to be considered in order to improve the agricultural information dissemination in WA. The issue of the inadequate ICT infrastructure to rural WA was raised by farmers as a problem that hinders their information gathering; however, the proposed National Broadband Network might be the answer to such problems.

Farmers expressed frustration when searching the Internet due to the overwhelming amount and the conflicting information available. This is consistent with Rin and Groves (1999) who analysed the special information needs of Australian farmers, finding that farmers expressed substantial frustration when searching the Web. Rin and Groves suggested providing training in searching techniques to farmers, among other recommendations; however, this might be considered a top-down approach. In addition, ―Internet search" continues to evolve as the use of smart-phones, portable tablet and specific farm-processes technologies replace the PC as the most-often used devices to connect to the Internet infrastructures. Thus, ten years on from Rin and Groves, Arumapperuma (2008, p. 98) suggests that ―a wide range of developments are needed to improve the ability of Australian farmers to use the Internet effectively for innovation diffusion".

The agricultural needs survey revealed that the majority of farmers stated that they lack adequate infrastructure which affects the ICT on their farms. This finding is consistent with Shiblag and Fielden (2008) who claimed that the inadequate ICT infrastructure in rural New Zealand partially delayed adapting ICT for agricultural purposes. Also, due to the overwhelming volume of information available either in print or in electronic form, it was stated that farmers do not have time to look for information, and they lose interest as they easily become lost searching the web. This is consistent with Rin and Groves' (1999) study findings that the most common problem faced by farmers was the overload of information available on the Internet. From farmers' perspective, information should be useful, relevant, seasonal and timely. Concerns were also raised regarding the legitimacy of information found or

delivered and its relevancy to WA farmer‘s region, farm or farming practice. Some farmers indicated that they trial new farming practices on a small scale before applying or considering them on a larger or permanent scale; because they were sceptical that the new farming practice might not apply to their local environment.

The methods of delivery of agricultural information to farmers are complex, are multiplying all the time and have started to overlap with each other. Farmers have many sources to choose from for their information needs; they believe that information is available but that ICT infrastructure provided by Telco‘s and the government is not adequate. This is consistent with the report by the ACMA (2008b, p. 35) which stated that —the farm sector report the highest levels of dissatisfaction in relation to mobile and Internet services”.

Develop & Support (Farmer) Communities of Practice

Farmers suggested that there is a need for more funding to the grower groups and more highly qualified staff employed at grower groups. In addition, information should be delivered via the Internet, and some suggested that social media networks, such as Facebook, could be used to promote agricultural information. This is consistent with Environmental Knowledge System Australia‘s (EKSA) suggestion that social media tools such Facebook and Twitter have the capacity to support future communication strategy or plan (EKSA, 2011).

5.5 Conclusion and future research

RQ 1. How can ICTs applications/technology devices and supporting infrastructure be used to support WA farmers’ decision making?

There are a number of ICTs applications/technology devices available to farmers to use in their decision making; for example the GPS technologies-precision farming concerning precise location on the farm and photo-sensitivity technology such as the weed control sensor (Simeoni, Galloway, O'Neil & Gilkes, 2009; Kodagoda & Zhang, 2010).

The results to open-ended questions, (Question,13, 15, 16, and 17), demonstrated that farmers do think that agricultural information should be delivered electronically;

however, they complained that one of their difficulties in using electronic channels to access information was the inadequate infrastructure and bad connectivity. One of the positive themes which emerged from the open-ended questions was that WA farmers perceive the mobility of information delivered by such ICTs as smart-phones and portable tablets allows them to send and receive information/data ‗in the field'. The bite-sized, and very specific, information delivered using these Web 2.0 mobile technologies, for example an APP with that day's or week's weather forecast is also effective at helping farmers sift-through the over-populated information structure of the Web 1.0 (traditional PC-Internet access). Both of these ICT-enabled information delivery contexts/channels require better infrastructure support in the form of mobile connectivity. The National Farmers' Federation (NFF), in its submission to the *2011–12 Regional Telecommunications Review*, has called on the government to improve its communication services to rural and remote areas—especially for those who are not covered by the new optical fibre network, because they need assurance that they will have adequate services through the existing copper landline network and future wireless and satellite mobile services. Moreover, it seems pointless having all these new information and telecommunication devices and applications while farmers cannot get adequate access to the telecommunication networks (National Farmers Federation, 2011c, para. 3 & 5).

Trusted sources of information

According to this study finding, farmers tend to look for needed information i.e. when a problem arises on their farms; secondly farmers look for solution by asking other farmers. That is, farmers tend to use information channels that are knowing or familiar to them. According to Bell (2002, p. vii), ―it is widely thought that farmers are conservative in their farming methods and require considerable persuasion to change their farming methods". The author added that farmers accept new innovations from trusted information sources, and that farmers are willing to copy something they see their neighbour is doing. Moreover, Woodgate and Love (2012, p. 3) stated that ―levels of literacy, age and willingness to change, and reliable access to the Internet influence the preferences of farmers when seeking out information". When it comes to adoptions, again, farmers adopt what other farmers have successfully adopted and

worked on their farms, by looking over the fence to their neighbours, or through farmer groups gatherings. This been the case, what does that mean for DAFWA, GRDC and other agricultural information providers? Having large amounts of information on the Internet via related websites is not necessarily the answer. Information providers need to look closely into ways to improve their interaction with farmers and try to disseminate agricultural information in formats and channels that are familiar to farmers using a bottom up approach rather than top down approach. According to Licht and Martin (2006), when commenting on crop producers, due to the growing number of information channels available, there is a real need to understand how crop farmers collect their agricultural information. The author added that —access to this information would enable educators and communicators to select the most efficient delivery methods" (p., 20). Farmers must be involved in the process of information delivery, which is a bottom-up approach where farmers make the request for the needed information from the information providers. Farmer groups can be seen as the champion when it comes to information delivery and trusted sources of information, as this study revealed that farmers see grower groups as a trusted information source. This can be taken into consideration by information providers in the information dissemination process to farmers. Specific smart-phone and/or tablet _APPS' that deliver highly specific bit-size pieces of information, for e.g., satellite/rain image for the exact GPS location of the held-hand device can help a farmer know whether it might rain in the next 30 minutes – which can impact a farming-related decision.

In conclusion it has to be emphasised that the objectives of this thesis were not aimed at evaluating the quality of agricultural information; rather they were on investigating the tools available to disseminate and retrieve agricultural information, the way farmers prefer to receive information and in which format. This being said, the inadequate infrastructure in most of the rural areas in WA, the large amount of information available to farmers and the legitimacy of the information found, retrieved and received are real issues that affect information dissemination to WA farmers. It was found that farmers prefer to receive their information via electronic means, in

printed form and face-to-face meetings, and from specialised agricultural advisors for specific issues that arise on their farm.

This study was guided by the answers to the survey, which led to some areas in WA and agriculture types not to be included, for example, there was no representation from the coastal south west, and diary farming and wineries was not included. In future studies, these areas and type of farming should be specifically targeted.

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Appendices

Appendix A: Informed Consent Documentation

A1. Email to be used to recruit participants

Dear Research Participant,

As a candidate for a Doctor of Information Technology degree at Edith Cowan University (ECU), Perth, Western Australia, I invite you to become a research participant in a study to investigate improvements to agricultural information dissemination in Western Australia.

Participation in this research project will involve one or more of the following:

- completing a survey

Any information collected will remain confidential.

The aim of this study is to improve dissemination of agricultural information and sustain agriculture related decision making in Western Australia by;

- Investigating the distribution of information to stakeholders (farmers, consultants, and agricultural scientists) in Western Australia
- Investigating the issues determining the provision of agricultural information and;
- Establish the methods by which stakeholders would prefer to receive information.

The estimated approximate time to complete the questionnaire will be 15 minutes.

The **Information Letter**, **Informed Consent Document** and the **Questionnaire** are attached with this email.

Thanks for your time

Regards
Hasham AL MUSAWI
PhD Candidate
Edith Cowan University
halmusaw@our.ecu.edu.au

A2. Information Letter to Participants

Dear Research Participant,

As a candidate for a Doctor of Information Technology degree at Edith Cowan University (ECU), Perth, Western Australia, I invite you to become a research participant in a study to investigate improvements to agricultural information dissemination in Western Australia.

The aim of this study is to improve dissemination of agricultural information and sustain agriculture related decision making in Western Australia by;

- Investigating the distribution of information to stakeholders (farmers, consultants, and agricultural scientists) in Western Australia
- Investigating the issues determining the provision of agricultural information and;
- Establish the methods by which stakeholders would prefer to receive information.

This research project has been approved by the Edith Cowan University Human Research Ethics Committee. To ensure confidentiality and anonymity, all provided data and information will only be used in this research study without identification of any person, organisation, time or place. The original questionnaires will be held in a secure place at the University for at least five years, as are all the data and information gathered. Only the researcher and the supervisors will be able to access data and information sourced from the questionnaire and no third parties will be allowed to access such information sourced in any form or shape.

Any information collected will remain confidential.

You, as a participant, have the right to withdraw from this research process at any time. Moreover, if you would like to remove all or part of what you have provided, this removal will be carried out according to your wishes.

If you require any further information concerning the research project, please contact:

Mr Hasham AL MUSAWI
Email: halmusawi@our.ecu.edu.au
Mob: 0411 524 943

Dr. Leisa Armstrong
School of Computer and Security Science
Mt Lawley Campus
Edith Cowan University
Phone: 61 8 93706506
Fax: 61 8 9370 6100
l.armstrong@ecu.edu.au

Dr. Judy Clayden
Senior Lecturer
School of Computer and Security Science
Edith Cowan University
Mt Lawley Campus
Western Australia
Phone: +61 8 9370 6298
Fax: +61 8 9370 6100
j.clayden@ecu.edu.au

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer

Edith Cowan University
100 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

Information Letter to Participants

Information dissemination strategies in the Western Australian Agricultural Industry

Dear Research Participant,

As a candidate for a Doctor of Information Technology degree at Edith Cowan University (ECU), Perth, Western Australia, I invite you to become a research participant in a study to investigate improvements to agricultural information dissemination in Western Australia.

The aim of this study is to improve dissemination of agricultural information and sustain agriculture related decision making in Western Australia by;

- Investigating the distribution of information to stakeholders (farmers, consultants, and agricultural scientists) in Western Australia
- Investigating the issues determining the provision of agricultural information and;
- Establish the methods by which stakeholders would prefer to receive information.

This research project has been approved by the Edith Cowan University Human Research Ethics Committee. To ensure confidentiality and anonymity, all provided data and information will only be used in this research study without identification of any person, organisation, time or place. The original questionnaires will be held in a secure place at the University for at least five years, as are all the data and information gathered. Only the researcher and the supervisors will be able to access data and information sourced from the questionnaire, and no third parties will be allowed to access such information sourced in any form or shape.

The first stage of the research will require all participants to complete a questionnaire which will include questions on demographic information such as age, level of

education, participation in farming industry; and questions related to the use of Information resources for decision making.

Any information collected from the questionnaire will remain confidential.

You, as a participant, have the right to withdraw from this research process at any time. Moreover, if you would like to remove all or part of what you have provided, this removal will be carried out according to your wishes.

If you require any further information concerning the research project, please contact:

Mr Hasham AL MUSAWI
Email: halmusaw@our.ecu.edu.au
Mob: 0411 524 943

Dr. Leisa Armstrong
School of Computer and Security Science
Mt Lawley Campus
Edith Cowan University
Phone: 61 8 93706506
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Dr. Judy Clayden
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School of Computer and Security Science
Edith Cowan University
Mt Lawley Campus
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Research Ethics Officer
Edith Cowan University
100 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

Informed Consent Document for farmers

Information dissemination strategies in the Western Australian Agricultural Industry

I understand that participation in this research project will involve one or more of the following:

- completing a survey

The estimated approximate time to complete the questionnaire will be 15 minutes.

I understand that the information provided will be kept confidential, and will only be used for the purposes of this project. This includes not being identified in the thesis or in any presentation using this information. I understand that I am free to withdraw from further participation at any time, without explanation or penalty.

I agree to participate in this project

Name: ……....

Signature: ……..

Date: ……

Appendix B: Questionnaire for the needs analysis

QUESTIONNAIRE: Please mark × in the □ in front of the choice you have made

Part I (demographic)

1. Gender

□ male □ female

2. To which age group you belong?

□ 18 – 20 □ 21 – 25 □ 26 – 30

□ 31 – 35 □ 36 – 40 □ 41 – 45

□ 46 – 50 □ 51 – 55 □ 56 – 60

□ 61 and over

3. Highest education level

□ primary school

□ high school

□ certificate

□undergraduate diploma

□ bachelor degree

□ master degree or higher

4. (Location) What is your post code?

□□□□

5. What is your occupation?

……

6. (Farm size) If you are a farmer, what is your farm size in hectares?

…….

7. (Agricultural Activity**)** If you are a farmer, please tick each type of agricultural activity (you may choose more than one)

□ crop grower (eg. wheat) please specifiy……

□ livestock (e.g., cattle) Please specify group……

□ Other (please specify) ……

Part II (Information resources)

8. What resources do you currently use to access agricultural information? (you may choose more than one)

□ TV	□ farmer group	□ other farmers
□ Internet/related website	□ radio	□ local library
□ home phone	□ mobile phone	□ printed material

□ personal knowledge

□ other (please specify)……...

9. *Accurate Ag Info (Likert scale)* Which of the following sources give you accurate agricultural information?

10. *Info Providers/Source (a):* Who or what are your **main agricultural information providers**? *(please rank from the most important to the least important) (most important is 1, least important is 13)*

□ 1- Other farmers

□ 2- Private company

□3 - Internet/related web sites

□4 - Extension worker

□ 5 - Printed materials and publications

□ 6 - Government officer

□ 7 - Local library

□ 8 - Brochures

□ 9 - Local news paper

□ 10 - Mobile phone

□ 11 - Farmer group

□ 12 - Personal knowledge

□ 13 - Other (please specify)……

11. *Type of Info:* What kind of information do you require? (you may choose more than one answer)

□ Cropping/varieties
□ Fertilizer management
□ Weather forecast
□ Farm sustainability (e.g. salinity)
□ Education/health information
□ Disease and pest control
□ Market prices
□ Financial advice
~~□ All of the above~~
□ Other (please specify……

12. *Accessing Info:* Which of the following organizations do you use to access agriculture related information?

□ DAFWA
□ Western Australian No-Tillage Farmers Association (WANTFA)
□ South East Premium Wheat Growers Association (SEPWA).
□ Australian Association of Agricultural Consultants (WA) Inc (AAAC)
□ Grains Research & Development Corporation (GRDC)
□ Grower Group Alliance (GGA)
□ Liebe group
□ Mingenew-Irwin
□ Kondinin Group
□ Other, please specify……

13. *Changes in Info Delivery:* Information delivery has changed great deal in the last 10 years, how has that effected the ways in which you gather information?

……..

……..

14. *Info Providers/Source (b):* Which of the following would you describe as your main information source **10 years ago**? Rank from the most important to the least important) (most important is 1, the least important is 13)

□ Other farmers
□ Private company
□ Internet/related web sites

□ Extension worker

□ Printed materials and publications

□ Government officer

□ Local library

□ Brochures

□ Local news paper

□ Mobile phone

□ Farmer group

□ Personal knowledge

□ Other (please specify)……

15. If you were able to decide how information should be most effectively delivered in the future; what would you suggest is required?

    ……

    ……

16. What difficulties do you encounter when accessing required information?

    ……

    ……

17. In your opinion, what can be done to improve agricultural information delivery methods to use in your decision making

    ……

    ……

End of Questionnaire

Thank you

Appendix C: Raw Data Tables

Q1: Gender				
	Gender		**#**	**%**
1	Female		18	22.8%
2	Male		61	77.2%
		Total	**79**	

Q2: Age Group				
	Age-group		**#**	**%**
1	18-20		0	0.0%
2	21-25		8	10.1%
3	26-30		13	16.5%
4	31-35		5	6.3%
5	36-40		9	11.4%
6	41-45		11	13.9%
7	46-50		12	15.2%
8	51-55		9	11.4%
9	56-60		4	5.1%
10	60+		8	10.1%
		Total	**79**	

Q3: Education				
	Completed Ed Level	**Bar**	**#**	**%**
1	Primary School		0	0.0%
2	High School		18	23.1%
3	Certificate		21	26.9%
4	Undergraduate Diploma		12	15.4%
5	Bachelor Degree		17	21.8%
6	Masters Degree or Higher		10	12.8%
		Total	**78**	

Q4: Location				
	Location	**Bar**	**#**	**%**
1	Central West		8	10.1%
2	Central Wheat Belt		37	46.8%
3	Gascoyne		8	10.1%
4	Great Southern		10	12.7%
5	Lower West		6	7.6%
6	South East Coastal		10	12.7%
		Total	**79**	

Q6: Farm size				
#	Farm size (hectares)		#	%
1	0,000-1,000 (v-small)		7	8.9%
2	1,000-2,500 (small)		12	15.2%
3	2,501-5,000 (medium)		22	27.8%
4	5,001-7,500 (med/large)		24	30.4%
5	7,501-10,000 (large)		8	10.1%
6	10,001+ (v-large)		5	6.3%
7	NA/Unknown		1	1.3%
		Total	**79**	

Q7: Farm Type				
	Answer	**Bar**	**#**	**%**
1	Crop Grower (e.g. wheat)		17	21.5%
2	Livestock (e.g. cattle)		6	7.6%
3	Crops & Livestock		56	70.9%
		Total	**79**	
Q7: Farm Type				
4	Total 'CROPS'		73	91.1%
5	Total 'Livestock'		62	77.2%
		Total	**79**	

Q8: What Information Resources are used?				
#	**Info Resource**	**Bar**	**#**	**%**
4	Famer Group		70	88.6%
2	Internet/website		67	84.8%
9	Printed Material		64	81.0%
7	Other farmers		60	75.9%
10	Personal Knowledge		44	55.7%
5	Radio		39	49.4%
6	Mobile phone		40	50.6%
3	Home phone		24	30.4%
1	TV		21	26.6%
8	Local Library		1	1.3%
11	*Other (specify)*	*inc. consultants/advisor; research/education*	*13*	*16.5%*
	Total		**79**	

Q9: Which sources provide the most accurate information (all answers)								
#	Info Sources	S-Agree	Agree	Neutral	Do not Agree	S- Disagree	DNA	/79
1	Other farmers	20	44	14	0	0	1	78
2	Local library	1	9	27	21	12	9	70
3	Extension workers	13	44	14	1	0	7	72
4	Private companies	11	37	26	1	0	4	75
5	Farmer groups	43	34	1	0	0	1	78
6	Government officers	9	45	18	0	1	6	73
7	Radio	4	37	28	4	0	6	73
8	Internet/Web	12	49	13	0	1	4	75
9	Mobile phone	5	34	27	7	2	4	75
10	Rural press	11	41	23	1	0	3	76
11	TV	1	21	43	7	0	7	72
Q8: Which sources provide the most accurate information (only 58 all-answered)								
#	Info Sources	S-Agree	Agree	Neutral	Do not Agree	S- Disagree	DNA	/58
1	Other farmers	18	31	9	0	0	0	58
2	Local library	1	8	21	17	11	0	58
3	Extension workers	11	35	11	1	0	0	58
4	Private companies	5	30	23	0	0	0	58
5	Farmer groups	31	26	1	0	0	0	58
6	Government officers	9	32	16	0	1	0	58
7	Radio	4	27	24	3	0	0	58
8	Internet/Web	8	38	11	0	1	0	58
9	Mobile phone	4	25	21	6	2	0	58
10	Rural press	10	30	17	1	0	0	58
11	TV	1	16	34	7	0	0	58

Q10. Most Important Info Channels (current)													Q14. Most Important Info Channels (10 yrs prev)											
# of ranked results	Other Farmers	Private Co's	Internet/web	Extension worker	Local library	Gov Officer	Brochures	Local Newspaper	Printed material / pubs	Farmer groups	Mobile phone	Personal Knowledge	# of users	Other Farmers	Private Co's	Internet/web	Extension worker	Local library	Gov Officer	Brochures	Local Newspaper	Printed material / pubs	Farmer groups	Mobile phone	Personal Knowledge
7	377	275	317	227	10	123	101	85	308	387	159	254	53	407	270	79	219	328	228	33	165	206	318	18	333
6	371	269	327	226	10	109	64	66	303	404	149	234	56	423	264	50	222	340	220	30	143	164	330	14	327
***5**	**399**	**232**	**325**	**211**	**24**	**118**	**39**	**31**	**266**	**421**	**149**	**221**	***60**	**417**	**234**	**51**	**226**	**326**	**229**	**27**	**110**	**145**	**336**	**14**	**294**
4	359	224	288	180	18	100	28	7	207	388	119	209	62	387	220	59	222	278	184	22	68	112	286	14	273
3	324	211	260	127	18	93	0	0	130	383	70	186	66	389	201	54	148	253	152	8	26	63	259	0	246
2	275	164	197	95	10	29	0	0	99	313	46	147	69	354	113	38	124	159	120	9	18	47	133	0	206
1	140	110	90	60	10	20	0	0	0	170	20	120	71	220	50	30	70	60	30	0	0	20	70	0	170

	Farmer groups	Other Farmers	Internet/web	Print mat/pubs	Private Co's	Personal Knwldge	Extension worker	Mobile phone	Gov Officer	Brochures	Local Newspaper	Local library
current	421(1)	399(2)	325(3)	266(4)	232(5)	221(6)	211(7)	149(8)	118(9)	39(10)	31(11)	24(12)
(BL) 10 yrs ago	336(2)	417(1)	51(10)	145(8)	234(5)	294(4)	226(7)	14(12)	229(6)	27(11)	110(9)	326(3)
	↑25%	↓4%	↑537%	↑83%	↓1%	↓25%	↓7%	↑964%	↓48%	↑44%	↓72%	↓93%

Q11: The type of Information Farmers Need (Information Need)					
#	Answer	Bar	#	Corrected	%
1	Cropping/varieties		73		89.02%
2	fertiliser management		71		86.59%
3	Weather forecast		77		93.90%
4	Farm sustainability (e.g., salinity)		62		75.61%
5	Education/Health information		46		56.10%
6	Disease and pest control		64		76.05%
7	Market prices		64		78.05%
8	Financial advice		51		62.20%
~~9~~	~~*All of the above*~~		~~**37**~~		
10	Other (please specify)		2		2.44%
		Total	547		

Q12: Agricultural Organisations?					
#	Answer	Bar	#	Corrected	%
1	DAFWA *(Department of Agriculture & Food WA)*		72		87.80%
2	Western Australian No-Tillage Farmers Association (WANTFA)		39		47.56%
3	South East Premium Wheat Growers Association (SEPWA).		18		21.95%
4	Australian Association of Agricultural Consultants (WA) Inc (AAAC)		24		29.27%
5	Grains Research & Development Corporation (GRDC)		62		75.61%
6	Grower Group Alliance (GGA)		37		45.12%
7	Liebe group		39		47.56%
8	Mingenew-Irwin		9		10.98%
9	Kondinin Group		32		39.02%
10	Other, please specify		14		17.07%
		Total	346		

Appendix D: Qualitative Analysis (Q13, 15, 16 & 17)

App D.1 Q13. Information delivery has changed great deal in the last 10 years, how has that effected the ways in which you gather information?

NB: GG = Grower Groups; ISB = Information Seeking Behaviour

#	Q-13. info deliver has changed ….	MY Words (summary)	themes (tech objects)	themes (behaviour)	themes/ results	prev research themes	prev rsrch themes (in **IQ dimensions**)
1	it's a lot easier to source via Internet	easier to source info (Internet)	↑NET	↑own (ISB) (choice of *source*)		↑*independence?*	
2	use technology more, Internet, mobile phone	more use of technology	↑NET ↑mobile tech	↑use			
3	quicker information, e.g. mobile phone, Internet, fax.. etc	quicker info	↑NET ↑mobile tech	↑*speed of* info			↑***currency***
4	Yes grower groups better targeting local concerns	GG better target local needs		↑local (GG) networks		↑*independence?*	↑***relevancy*** (local-*scope*)
5	a lot of information gathered from e-news/email and Internet	more info gathered	↑NET ↑email	↑*amount of* info		↑info amount	↑***access*** (amount)
6	more technology used / more contact overall	more contact /connected because of more tech	↑ICT	↑ICT use ↑contact			↑***connectivity***
7	Internet services		↑NET	↑use			
8	Wheat marketing SMS notices of wheat prices. / iPhones access most things in the iPad / Agronomy advice /	better access to business / market processes (mobile/SMS)	↑mobile tech (iPad)			↑access (targeted)	↑***relevancy***
9	More through Liebe Group / Internet	more info (thru Internet & GG)	↑NET	↑info	↑new networks (GG/Liebe)		
11	Independent and local based information led to the formation of the Liebe Group. With the Internet and mobile phones we are now able to source information 24/7 to have locally designed grower trial is extremely valuable. We are overwhelmed with technology at times so we are always evaluating to truth, accurate results from the bullshit	GG = better independent/local info 24/7 access to source info *tech overwhelming*	↑NET ↑mobile tech	↑*amount of* info ↑access (24/7) to info	↑new (local) networks (GG/Liebe)		↑***relevancy*** (local-*scope*) [GG] ↑***access*** (timing) i.e., ↑***currency*** ↑***access*** (amount)
12	More grower groups, Internet and new technology	More GG, more IT	↑ICT use ↑NET		↑networks (GG)		
14	Information can be gained in the paddock, smart phone on web	better access info (location)	↑mobile tech	↑access (location)			↑***access*** (location) *accessibility; usability*
15	Internet		↑NET				
16	Use Internet for research / Email to receive updates / Still find farm papers and focus on Ag in hard copies /	more research (Internet) more currency (email)	↑NET ↑email		↑research ↑**ISB** (*source*)		↑***currency*** (email) ↑*independence?*

17	More Selective / Seek Neutral and Independent Information / More Participatory Action Research /	More selective/choices Better independent info Greater research participation			↑(ISB) (choice of *source*) ↑research participation (*ownership*)	↑*independence?*	↑ ***relevancy*** (choice) ↑info ***objectivity***
19	Rely on professional advice more. / Rely on contractors more. / Internet access. /	More reliance on Consultancy, GG & Internet	↑NET	↑reliance on consults, & professional networks	↑new networks (GG) ↑ ICT & GG ***reliance***	↑*independence (from gov)?* ↑*inter-dependence (other farmers)*	
21	Information overload. I only choose specifically now information get to you	information overload (overwhelming)		↑info (overload)	↑*active choice* in ISB	↑*independence*	↑choice (amount)
22	More use of Mobile Phones, emails and iPads	more use of ICT	↑email ↑mobile tech (iPad)				
23	Distance does not matter anymore- to fly interstate is easy and info can transfer at click of a button	more connected (distance not a hindrance)(better network)		↑connected		↑connectivity	↑access (location) ***accessibility***
24	more on the Internet with the demise of DAFWA	more use of Internet, less DAFWA	↑NET	↑info	↑new networks ↓DAFWA		
25	Information overload! Certainly do not need to research information much. It is constantly arriving via post, email	info overload (overwhelming)	↑email	↑info (overload)			
26	More web based information	more web-based info use	↑NET	↑info			
27	Information is easily accessed through Internet and mobile phones.	easier access thru ICT	↑NET ↑mobile tech				↑access (easy) ***usability accessibility***
28	Internet and mobile are playing an ever increasing role	greater role by ICT (reliance?)	↑NET ↑mobile tech		↑ ICT **reliance**		
29	Relying on the Internet use to get up to date information	more currency (Internet)	↑NET		↑ ICT **reliance**		↑*currency* (NET)
31	Most Information now comes from email, which is good as you can delete info that is not relevant	more info (email), easily discard irrelevant info	↑email	↑management of info			↑choice (***relevancy***)
33	Internet / Grower Groups		↑NET		↑new (GG) networks		
35	Access through Internet. / Mobile phone access direct to Dedicated print media. Grower Groups trials and information /	better access (more direct) thru Internet/mobile. more access to new research (GG)	↑NET ↑mobile tech		↑new (GG) networks	↑participation (*ownership*)	↑access (direct) ***usability accessibility***
36	A lot of information now available at fingertip i.e. Internet, very good	more/better access (convenient)	↑NET	↑info	↑info availabil		↑access, convenience,

					ity		***accessibility***
39	Internet		↑NET				
40	Mostly Internet and farmer groups		↑NET		↑new (GG) networks		
41	Information and Communication Technology		↑ICT use				
42	easier to source via Internet	easier to source info (Internet)	↑NET		↑ISB(*source*)	*↑independence?*	
43	More available and quicker information, e.g. mobile phone- Internet- fax	more info available, quicker	↑NET ↑mobile tech				↑info amount ↑info speed ***currency***
45	Much greater use of web access to information	more use of ICT	↑NET	↑info	↑ ICT **reliance**		↑access (convenience) ***accessibility***
46	The Internet has become a very important tool	become important tool	↑NET				
48	Internet used as a major mechanism to find information (especially initially) / Major limitation with mobile phone coverage is an issue	increased capacity to FIND info	↑NET		↑ISB(*source*)		
50	How has it changed? I still get the information from the grower groups and Ag Department same way as it has been.	little has changed (user 20-25)					
51	It is easier now, more available but still use same groups	access to info easier; more info available					↑access (easy) & **availability** (convenience) ***accessibility / usability***
52	Internet		↑NET				
53	use the Internet a lot more and email	more use of Internet & email	↑NET ↑email				
54	A lot of information is collect via either through Internet or email. Type of info collect is usually research, trial results and reports. Daily reports also emailed. / Mobile phone text is also used a lot especially during busy periods. Again reports (markets). Disease out beaks, harvest bans and issues effecting the farming operation at that particular time. As a farmer i will go looking for the information now as for 15 years ago i would attend a field days and seminars but there has to be information that i am interested in. I need to see the agenda and who is presenting etc.	more info available (Internet/email) more individual search/finding than before	↑NET ↑email ↑mobile tech		↑ISB(*source*)		↑info availability (***accessibility***) ↑choice (***relevancy***) *↑independence?*
55	Email newsletters are my primary source of information / Facebook is becoming more useful as we work it out /	electronic delivered info	↑email ↑SocNET		↑ISB(*source*)		↑access (availability) ***accessibility***
56	Electronic/Internet and email		↑NET ↑email				
57	Information accessed electronically	more electronic interaction	↑electronic	↑electronic interactions	↑ISB(*source*)		↑access
60	email, immediate	immediate information (currency)	↑email				↑immediacy ***currency***
62	Internet/email		↑NET				

			↑email				
63	I source a lot of information from the Internet, and a lot of reading material now comes in email newsletters. / It is harder to get hold of anyone in DAFWA with experience (hard to get hold of anyone in DAFWA full stop) so I rely more on ag consultants. / Questions are asked and answered by email. Internet speeds and dropouts are a problem, as is mobile phone coverage. I receive market info by text. / I still like to read the Ag papers in paper copy.	more sourcing info (Internet) more info exchange (email) more ag. consultancy (less Gov/DAFWA) more market info (mobile/SMS)	↑NET ↑email ↑mobile tech	↑Consultants and ↓DAFWA	↑ISB(*source*) ↑info exchange (connectivity)		↑**relevancy** (SMS)
66	With technology become more accessible, the Internet has provided a great source of information, however hard copy information from research groups is still a valuable asset. Mobile phones are useful but with coverage issues this is not as reliable.	more sourcing info (Internet); more useful (mobile)	↑NET ↑mobile tech		↑ISB(*source*)		↑access (availability) ***accessibility*** ↑coverage problems
67	Internet/mobile		↑NET ↑mobile tech				
68	Email & SMS have greatly improved timeliness of receiving information. The net is now the main source of researching information. New ideas and research findings need to be reported in rural press and publications. The ranking below greatly change with the different information that is required.	better timeliness/currency (email/SMS); main info source (Internet); new ideas not in rural press	↑NET ↑email ↑mobile tech		↑ISB(*source*)		↑timeliness (email, SMS) ***currency*** ↑new ideas/innovation
70	Too much information available so have had to learn to priorities. Read a lot what I need to know not what I would like to know	information overload		↑info (overload)			
71	Time is in short supply / / Half day seminars are good / Radio inferring are excellent /	less time to get info than previous	↑Seminars ↑Radio				
72	We have moved in times, Mags still important	moved away from print (mags still important)	↑non-print (mags still imp)				
73	More Internet especially with searching by Google	more searching (source)	↑NET		↑ISB(*source*)		
76	Use Internet extensively, current and usually up to date. / No need to store paper files anymore /	more Internet use, more currency/up-to-date; better storage (electronic).	↑NET ↑non-print				↑timeliness (NET) ***currency***
77	Information can be obtained a lot quicker and from the padock eg, not having to go to officer.	more quick info; better access info (location)	↑mobile tech				↑info speed ***currency*** ↑access (location) ***accessibility***
78	More participatory research being conducted through grower groups. / Less government agencies involvement, more paid consultants. / Information gathered from numerous sources /	better participation (relevancy); multiple sources of info			↑Consultants ↑new networks (GG)		↑participation (***relevancy***) ↑sources (***objectivity***)
79	More reliant on the Internet rather than libraries or other people / (face to	more reliance on cyber (than physical); more			↑reliance on		↑timeliness (now as

	face/phone calls) / Important-want information now- as we are now able to get it on the go /	current; more on-the-go			cyber than physical		needed) ***currency /availability*** ↑access (convenience) ***accessibility***
80	Easily a more accessible / More data available to make better decision /	more accessible, more available					↑access (available) ***availability***
82	More dependent on online sources. Makes it quicker to find relevant information	more reliance on cyber; more quickly find relevant info			↑relianc e on cyber		↑info speed ***currency***
83	Research info through trials, written reports, access GRDC + Ag Dept web sites. Be flexible and keep up with new ideas + see if they suit my farming system. Keep to a plan + usually takes time to change once I am convinced it will work for me.	more flexibility; supports keeping up with new ideas;	↑NET	↑time required to learn new ICT		↑participati on (*ownership*)	↑access (available) ***availability*** ↑flexibility ***accessibility*** ↑up-to-date ***currency***

App D.2 Q16. What difficulties do you encounter when accessing required information?

#	Q16. What difficulties do you encounter	MY Words (summary)	(tech) issue	(behaviour) issue	themes/ results	prev research themes	prev rsrch themes
1	crap search engines		↓search engines	↓finding relevant information	↓relevant information		↓ finding needed information
2	none						
3	poor mobile phone coverage, slow Internet	Inadequate Infrastructure	↓coverage ↓speed	↑frustration & loose of interest	↓Informatio n delivery channels (ICT)		↓ finding needed information (**accessibility**)
4	Lot of non relevant information, conflicting information	a lot of info, but not always relevant and contradicts other info	↑non-relevant info ↑conflicting info		• user has to ***decide quality***		↓finding info (↓***relevancy***)
5	finding specified information as sometimes there is an overload of quantity of information rather than quantity and specified information	Overwhelming amount of information	↑*amount of* info	↓finding specific info (amount)	• user has to ***find quality***		↓finding info (↓***relevancy***)
6	Coverage; Internet and Phone	poor coverage, difficult using phone/Internet (not specified)	↓coverage	↑frustration & loose of interest	↓Informatio n delivery channels (ICT)		↓***accessibility***; ↓***usability***
7	Poor coverage		↓coverage				
9	Enough time to read it all	too much info? not enough time to read it	↑non-relevant info ↑conflicting info	↓time to digest info	↑Overwhel ming amount of information		↓relevancy
14	Some websites are difficult to navigate to the information you want	Some Websites not specific enough	↑non-relevant info ↑conflicting info	↓finding specific info (usability)	user has to ***find quality***		↓finding info (↓***usability***)
15	Conflicting Data		↑conflicting info		• user has to decide		↓relevancy

					quality?		
17	Find relevancy amongst a lot of information	Overwhelming amount of information	↑amount of info	↓finding relevant info	• user has to ***find quality***		↓***relevancy***
19	Mobile phone and Internet coverage	ICT coverage	↓coverage	↑frustration & loose of interest	↓Information delivery channels (ICT		↓ finding needed information (**accessibility)**
21	Nil with Google search						
23	too much information. / sale's people getting in the road	Overwhelming amount of information/ conflicting info	↑non-relevant info ↑conflicting info	↓finding specific info (usability)	↑Overwhelming amount of information / ↑conflicting info		↓***relevancy***
25	too much information and too many varied sources / slow Internet / complexity of information	Overwhelming amount of information/ conflicting info/ Inadequate Infrastructure	↑amount of info ↑non-relevant info ↑conflicting info ↑ Inadequate Infrastructure	↓finding specific info (usability)	↑Overwhelming amount of information / ↓ varied Delivery methods ↑conflicting info ↑ Inadequate Infrastructure		↓***relevancy***
26	filtering information on web	Overwhelming amount of information	↑Overwhelming amount of info ↑non-relevant info	finding specific info (usability)	↑Overwhelming amount of information		↓***relevancy***
27	Internet Connection / Too many unreliable sources	ICT Coverage/ Inadequate Infrastructure/ unreliable Information delivery channels (ICT)	↓coverage	↓finding relevant info	↑ Inadequate Infrastructure ↓ unreliable Information delivery channels (ICT)		↓ finding needed information (**accessibility)** ↓***relevancy***
28	Cutting through all the b-llshit to find what relevant and not put out by someone/group with a vested interest	Overwhelming amount of information	↑Overwhelming amount of info ↑non-relevant info	↓finding relevant info	• user has to ***decide quality***		↓***relevancy***
31	Deciding if the source is credible	Credibility of Information Channels	↓finding relevant information	↓finding specific info (usability)	• user has to ***decide quality***		↓***relevancy***
33	Ads						
35	Slow Dial up / Generalisation of information not direct enough / Time to do research /	ICT Coverage/ Inadequate Infrastructure/conflic	↓Coverage ↓finding relevant	↓finding specific info (usability)	• user has to ***decide quality***		↓ finding needed information

		ting info/ amount of information	informatio n				(**accessibility**) ↓***relevancy***
39	slow Internet	ICT coverage	↓Coverage	↓Finding needed information	↑ Inadequate Infrastructu re		↓ finding needed information (**accessibility**
40	Internet phone range	ICT coverage	↓Coverage	↓Finding needed information	↑ Inadequate Infrastructu re		↓ finding needed information (**accessibility**
41	Internet/Mobile Coverage	ICT coverage	↓Coverage	↓Finding needed information	↑ Inadequate Infrastructu re		↓ finding needed information (**accessibility**
42	crap search engines		↓search engines	↓finding relevant information	↓relevant information		↓ finding needed information
43	slow Internet - poor mobile phone coverage	Inadequate Infrastructure	↓coverage ↓speed	↑frustration & loose of interest	↓Informatio n delivery channels (ICT)		↓ finding needed information (**accessibility**)
45	Net work speeds	Inadequate Infrastructure	↓coverage ↓speed	↑frustration & loose of interest	↓Informatio n delivery channels (ICT)		↓ finding needed information (**accessibility**)
46	out of date websites and news papers have some bias towards adverts	Available websites contents/ conflicting info	↓Informatio n quality	↓Finding needed information	↓Informatio n delivery channels (ICT)		↓ finding needed information (**accessibility**
48	Lack of mobile coverage / Time constraints / Conflicts with commercial "sell more" perspective / Lack of independent reliable information as per OCD AE. DEPT /	ICT coverage/reliability of info/ conflicting info	↓Coverage	↑frustration & loose of interest	↓Informatio n delivery channels (ICT)		↓ finding needed information (**accessibility**) ↓***relevancy***
52	Relevant of information	Information quality	↓finding relevant informatio n	Info not specific enough	• user has to ***decide quality***		↓***relevancy***
54	Mobile and Internet speed / Time is also an issue. knowing where to go for information and wasting time on websites trying to find links etc.	ICT coverage/ amount of info/Available websites contents/ reliability of info/ conflicting info	↓Coverage ↓finding relevant informatio n	↓Finding needed information	• user has to ***decide quality***		↓ finding needed information (**accessibility**) ↓***relevancy***
55	Internet service difficulties - mainly mobile service	ICT coverage	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructu re		↓ finding needed information (**accessibility**)
56	as above						
57	Internet speed/mobile coverage	ICT coverage	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructu re		↓ finding needed information (**accessibility**)
60	in a black hole with the use of mobile	ICT coverage	↓Coverage	↑frustration	↑		↓ finding

	phone coverage and slow Internet speed			& loose of interest	Inadequate Infrastructure		needed information **(accessibility)**
62	Mobile reception/Internet speed	ICT coverage	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructure		↓ finding needed information **(accessibility)**
63	see above (*better mobile phone coverage so a smart phone works here - even a normal mobile phone to make and receive calls would be good! / Better and faster Internet coverage without drop outs and time outs. / a revived DAFWA with experienced staff as they are independent* .)	ICT coverage/more experienced staff	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructure		↓ finding needed information **(accessibility)**
65	Internet speed, mobile connection	ICT coverage	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructure		↓ finding needed information **(accessibility)**
66	slow Internet speeds, poor mobile phone reception and signal coverage, mail delivery is only twice a week	ICT coverage/hard copies (newspaper)-info delivery channel	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructure		↓ finding needed information **(accessibility)**
68	Slow download speed, poor telephone signal (reception)	ICT coverage	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructure		↓ finding needed information **(accessibility)**
70	Articles in print information often too lengthy, a lot of wards not much information	Information quality/amount of info	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***
71	Not very computer savvy / Need to understand how to access materials	ICT training	↓Use of ICT	↓Finding info using ICT	↓Up to date information		↓ finding needed information-ICT **(accessibility)**
72	use phone, easy	Use of ICT	↓Use of ICT	↑Finding info using ICT-landline	↑Up to date information		↓ finding needed information-ICT **(accessibility)**
73	Would like to set other suggested search phases for Internet searching	Use of ICT	↑Use of ICT	↑Finding info using ICT-landline	↓Up to date information		↑ finding needed information-ICT **(accessibility)**
76	The stir volume of information can be confusing (websites). A pretty good understanding of local conditions and needed to sift through all the information and find what is relevant locally.	Amount of info on websites/conflicting info	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***
77	Lack of mobile service	ICT coverage	↓Coverage	↑frustration & loose of interest	↑ Inadequate Infrastructu		↓ finding needed information

					re		(accessibility)
78	Understanding what is credible and unbiased / Tracing back the source of the information /	Reliability of delivery channels/conflicting info	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***
79	Sifting through the rubbish / Knowing who is credible / Dated information /	Reliability of delivery channels/amount of info/conflicting info	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***
80	Accuracy of data / To much conflicting results / Local/district relevance /	amount of info/conflicting info	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***
82	Insuring it is relevant to the local area	Info relevancy	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***
83	Time researching an enquiry. Usually collecting info throughout the year.	Amount of info- time to find info	↓finding relevant information	↓Info not specific enough	• user has to ***decide quality***		↓***relevancy***

App D.3 Q15. If you were able to decide how information should be *most effectively delivered in the future*; what would you suggest is required?

#	Q15: Future effective info delivery	MY Words (summary)	What is required	Accessibility	themes/ results	prev rsrch themes	prev rsrch themes
1	more web/it data sourced easier to access	More websites	e-delivery channels	Faster-easier	↑e-delivery channels		Better ICT
3	need for better coverage for Internet, mobile phone	ICT Coverage	Better infrastructure	Faster-easier	e-delivery channels		Better ICT
5	sms, email, mobile phones	Use of ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
6	Radio / Grower Group / Publications		ICT, GG, printed materials	Specifically target locals	Mixed delivery channels		Mixed delivery channels
7	Mobile, Internet	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
8	By email	ICT	e-delivery channels	Faster-easier	e-delivery channels		Use of ICT
9	Grower Groups / Internet	GG/ICT	GG/e-delivery channels	Specifically target locals	Mixed delivery channels		Mixed delivery channels
11	Grower groups!!! The money saved from the reduction in DAFWA centres needs to be put into the Groups.	More support to GG	GG support	Specifically target locals	GG		GG
12	more grower groups, more support to grower groups	More support to GG	GG support	Specifically target locals	GG		GG
15	Extension Workers		More extension workers	Target specific issues on ground	Face to face communication		Face to face communication
17	Through grower group and Participatory Action Research / Need a strong collaboration between research and farmers /	GG/ collaboration between information provider/generator and farmers	GG support/bottom up approach	GG-Networking	GG support/bottom up approach		GG support/bottom up approach
19	More reliable mobile phone and Internet coverage	ICT Coverage	Better infrastructure	Faster-easier	e-delivery channels		Better ICT

20	More reliable mobile phone and Internet coverage	ICT Coverage	Better infrastructure	Faster-easier	e-delivery channels		Better ICT
21	Smart Phone Applications	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
22	iPad Applications	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
23	Via people who have feet on the ground and understand the complexity of agriculture in our environment. The right people can direct us to the right spot as it is easy to be overload with information that is not relevant	Face to face contact/specific and relevant information	More extension workers	Target specific issues on ground	Face to face communication		Face to face communication
24	by the Internet	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
25	Email and links to web / IPhone Applications / Some written- but probably complied more effectively, so there was less frequency but more information. / Demonstration sites and field days /	ICT-mixed info channels-specific information	Mixed delivery channels	Target specific issues on ground	Mixed delivery channels		Use of ICT/Face to face communication
26	iPhone / Internet / podcasts	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
27	Internet and Mobile	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
28	The hard printed copy still good - I do not like to spend all night in front of my computer	Use of Printed materials	Use of Printed materials	Use of Printed materials	possible ICT training needed		possible ICT training needed
29	delivery through farmer group and Internet/email	GG/ICT	More support to GG/use of ICT	GG Networking/ICT	Mixed delivery channels		Mixed delivery channels
33	Fast Internet with mobile coverage	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
35	Ease of access / Plain English so it can be disciplined	Info accessibility-ICT/specific information	Better infrastructure				
36	Ideally channelled through grower groups	GG	More support to GG	GG networking	Specifically target locals		GG networking
40	IPhone Compatibles	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
41	Faster Internet/Mobile Connection	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
42	more website data sourced easier to access						
43	Internet - mobile phone need better coverage for both	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
45	Tailored information through email and Internet. / / Use of twitter and SMS to provide topical information and information concerning events / / Information needs to be designed for hand held devices such as iPhone and iPad. / / greater use of video presentations webinars. / / Field day type talks should be filmed and available to search given how busy everyone is	ICT –filed days	Better infrastructure	Faster-easier	Mixed delivery channels		Mixed delivery channels
46	mobile phone and Internet	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
48	Internet-Good Sites / Emails-concise with Line (Basic email no more than A4) / Mobile Phone Coverage / Adoption of cloud computing (AE. World)	ICT coverage-better sites-specific info	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT

51	Probably mobile and printed	ICT-printed media	ICT-printed media	?	Mixed delivery channels		Mixed delivery channels
52	Information is already readily available	Amount of info available					
54	I can see I-pads being popular. The main issue with information delivery is availability of mobile reception sati lights and broadband. The quality and availability can vary a lot throughout the state.	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
55	It is hard to know - i-pad equivalent is going to be a must.	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
56	Internet/Mobile connection/speed	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
57	a better access to Internet/email/mobile services- social media such as Facebook	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
60	useful, succinct, relevant, timely	Specific information and on time	Info relevant to local	Face to face?	networking		networking
62	Internet connection and mobile reception	ICT coverage	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT
63	better mobile phone coverage so a smart phone works here - even a normal mobile phone to make and receive calls would be good! / Better and faster Internet coverage without drop outs and time outs. / a revived DAFWA with experienced staff as they are independent .	ICT coverage-more experienced staff at DAFWA	Better infrastructure-greater DAFWA involvement	Faster-easier-face to face communication	Mixed delivery channels		Mixed delivery channels
66	In both a hard copy form and via email, Internet.	Printed & ICT	Better infrastructure-printed media	ICT-Use of Printed materials	Mixed delivery channels		Mixed delivery channels
68	Combination of radio, rural press, publications, field days, web, newsletter, email	Info delivered through Mixed channels	Better infrastructure-more professional staff-more resources	Mixed delivery channels	Mixed delivery channels		Mixed delivery channels
70	Relevant shorter & succinct article not too many glossy pictures. Warnings, give out awareness information, presentation than reactive.	Specific info, relevant to locals	Better understanding of farmers needs	Target specific issues	Info quality		Info relevancy
72	As is / Interne too time consuming in sourcing info	Amount of info	Target specific issues, info relevant to locals	Target specific issues	Info quality		Info relevancy
75	Printed media and then you can reuse it as required	Printed materials	Printed materials	Printed materials	Printed materials		Printed materials
76	Personally, I find the current system works well (ie Internet, field days). The younger generations have different ideas, and it those that need pursuing.	ICT-target younger generation/field days	ICT- face to face communication	ICT-bottom up approach	ICT-bottom up approach		ICT-bottom up approach
77	IPad/iPhone apps and friendly documents	ICT	Better infrastructure	ICT	ICT		ICT
78	Information needs to be validated before decision can be made with it. / Plain information is worthless without providing ongoing support for further adoption of the technology. This support needs to be hands on. / Grower groups fill this role better. /	Info quality-ongoing support/ GG	Better information flow-face to face communication	GG Networking	GG networking		GG networking information quality

79	More interactive / Different media types- videos, apps etc /	Networking- ICT	Better information flow	Mixed delivery channels	Mixed delivery channels		Mixed delivery channels
82	A mixture of practical, hands on workshops and articles/ reports	Face to face communication- printed media	Better information flow- networking	Information relevancy	Mixed delivery channels		Mixed delivery channels
83	Delivered by phone or computer	ICT	Better infrastructure	Faster-easier	e-delivery channels		Use of ICT

App D.4 Q17. In your opinion, what can be done to improve agricultural information delivery methods to use in your decision making?

key: *CoP = Communities of Practice

#	Q17: what can be done to improve ...	MY Words (summary)	ICT nodes	Farmers (behaviour)	emerging themes	prev rsrch themes
1	better at base search engines/data bases	↑data and crawlers	↑ built data & ways to search it (independently?)	improved interaction/ ways to search/ retrieve data	↑independence	»independence /decision-making
2	Not much					
3	upgrade the phone coverage and speed up Internet. more support for grower groups	↑mobile coverage and data speed~~/~~ ↑GG support	↑ mobile coverage ↑data speed	↑mobility & independence) ↑data speeds = quicker choices ↑support for local networks	↑mobility ↑independence ↑local networks	↑ICT facilitation ↑independence/decision-making ↑CoP*
6	As above (Coverage; Internet and Phone #16)	↑coverage; ↑Internet (speed/coverage?); ↑mobile phone support	↑coverage, Internet & mobility	↑mobile coverage (↑mobility & indep)	↑mobility ↑independence	↑independence/choice-making
7	Better phone coverage	↑mobile coverage	↑coverage and mobility		↑mobility ↑independence	
8	With the weather forecasting productions become more accurate this will help with time of sowing and spraying	Better targeted info/data	↑specificity of data	↑specific application of specific data to farmer needs	↑targeting farmer info needs (data and timing)	•info relevancy •info currency
16	More support of farmer groups / More government information to be provided through DAFWA /	↑GG support ↑gov info provision	↑network connectivity (local & system) between GG, gov agency & local	↑connectivity, networking & interaction all levels of system	↑ info networks (local & system)	↑info networks (local info networks; system info networks) ↑CoP
17	Improve relevancy by targeting research and closer links between researchers and farmers	Better targeted info/data through closer networks (sys-to-local)	↑network connectivity (local & system) ↑specificity of data	↑connectivity, networking & interaction between local environ & sys environ ↑farmer (local) input	↑ info networks (local & system) ↑relevancy ↑farmer (local) input (Bottom up approach)	↑info networks (local info networks; system info networks) ↑CoP ↑Bottom-up business model
19	More reliable mobile phone and Internet coverage	↑reliability of mobile & Internet coverage	↑network connectivity thru ***reliability***	↑network reliability	↑reliability	↑reliability
21	Phone Applications	↑applications (APPS)	↑smart-phone APPS	↑specific interaction	↑specific-task/info	↑***info need***

		for smart-phones		driven by task	interaction	driven change
22	Ask what information farmers want	↑targeted info/data through ↑direct contact	↑connectivity	↑direct connectivity between farmers & info providers ↑to b heard/consulted	↑direct connectivity ↑Bottom-up business model	↑connectivity (direct) ↑ownership & relevancy ↑Bottom-up model
23	Group sessions with video via Skype to access experts advice the nation and the world. Keeping sales people out of it via advertising - Try to fund it through the industry rather than through companies who are selling products	↑Web2.0 techs & social-media to access expert info ↑industry-driven ICT change (not vendor-driven)	↑Web2.0 ICT, inc APPS, social-media	↑direct connectivity between farmers & info providers ↑to b heard/consulted ↑farmers drive change	↑direct connectivity ↑Bottom-up business model	↑connectivity ↑currency ↑ownership & relevancy ↑Bottom-up model
25	More interpretation of raw data and disseminated in a way that is clear and easy to understand / Using models such as the climate champion program which enables farmers to present scientific information to farmers and to interact with scientists and researches on what farmers want/need /	↑interaction between farmers & researchers ↑use of APPS that facilitate interaction	↑local (farmer) driven interaction	↑direct connectivity between farmers & researchers ↑farmers drive change	↑Bottom-up business model	↑***info need*** driven change ↑Bottom-up model
26	less rubbish. On a website that can search Databases of legitimate websites	↑data and crawlers	↑ built data & ways to search it (independently?)	improved interaction/ ways to search/ retrieve data	↑independence	»independence /decision-making
28	Clear course and pitched at a higher level â€“ do not dumb it down	↑interaction between information providers and farmers	↑specificity of data	↑farmers input	↑direct connectivity ↑Bottom-up business model	↑connectivity ↑currency ↑ownership & relevancy ↑Bottom-up model
29	Probably maintain sources in collaborating the average of accessibility of information	↑interaction between farmers & researchers- ↑accessibility "sources of information"	↑accessibility verses the amount of delivered information-find balance in between	improved interaction /collaboration	↑Connectivity- ↑sources accessibility	↑***info need*** sources accessibility ↑Bottom-up model
31	Have standardised information, each company seems to think their product is the best we have to sort out good from bad data	↑data and crawlers	↑Trusted sources of information	↑Specific & relevant information	↑independence	»independence /decision-making
33	less surveys	?	?	?	?	?
35	Direct some publications. / good mobile phone access to company rep's	↑ Better targeted info ↑reliability of mobile & Internet coverage	↑specificity of data ICT network connectivity	↑specific interaction driven by task	↑specific-task/info interaction	↑***info need*** driven change ↑reliability
36	Accurate counting i.e. returns on investment rather than entirely yield benefits	↑ Better targeted info	↑specificity of data	↑Specific & relevant information	↑independence	↑ownership & relevancy
40	better phone coverage	↑mobile coverage	↑coverage and mobility		↑mobility ↑independence	
41	Coverage	↑mobile coverage	↑coverage and mobility		↑mobility ↑independence	
42	better at base search engines/data bases	↑data and crawlers	↑ built data & ways to search it (independently?)	improved interaction/ ways to search/ retrieve data	↑independence	»independence /decision-making
43	upgrade the phone coverage speed up Internet. growers groups like Liebe are vital to keep information been delivered to farmers	↑network connectivity (local & system) between GG, gov agency & local	↑connectivity, networking & interaction all levels of system	↑ info networks (local & system)	↑info networks (local info networks; system info networks) ↑CoP	↑network connectivity (local & system) between GG, gov agency & local
45	Targeted to what I need to make	↑interaction	↑local (farmer)	↑direct connectivity	↑Bottom-up	↑***info need***

	decisions. / / Need information to be timely and relevant	between farmers & researchers ↑use of APPS that facilitate interaction	driven interaction	between farmers & researchers ↑farmers drive change	business model	driven change ↑Bottom-up model
46	Faster Internet connection and a better mobile phone service. More focus on the real issues in farming ie costs	↑reliability of mobile & Internet coverage ↑specificity of data	↑network connectivity thru ***reliability***	↑network reliability ↑Specific & relevant information	↑reliability	↑reliability ↑Relevancy
48	Adoption of IPAD's, Clouds computing. / Open forums (Internet) with other farmers	↑farmers network connectivity ↑use of APPS that facilitate interaction	↑local (farmer) driven interaction	↑direct connectivity between farmers ↑farmers drive change	↑Bottom-up business model	↑***info need*** driven change ↑Bottom-up model
51	Nothing	?	?	?	?	?
52	Double up of information given by too many groups	↑ Better targeted info by GG	↑specificity of data	↑Specific & relevant information	↑independence	↑ownership & relevancy
54	I think a lot of my suggestions are being put in place. / have at least one good provider for all the farming area. Make mobile reception available for all farmers (rural people) to use. / Set-up i-pad system for all farmers, Researchers, Consultants and Department of Agriculture which can be used and to communicate with each other. / you are not going to connect with all farmers due to some are not interested in keeping up. Look after the keen ones.	↑interaction between farmers & researchers ↑use of APPS that facilitate interaction	↑local (farmer) driven interaction	↑direct connectivity between farmers & researchers ↑farmers drive change	↑Bottom-up business model	↑***info need*** driven change ↑Bottom-up model
55	Internet connection	↑Internet connection	↑coverage and mobility		↑mobility ↑independence	↑Internet connectivity
56	improve infrastructure re Internet and electronic information transfer	↑better ICT infrastructure	↑network connectivity thru ***reliability***	↑network reliability	↑reliability	↑reliability
57	Improve Internet speed/mobile coverage	↑reliability of mobile & Internet coverage	↑network connectivity thru ***reliability***	↑network reliability	↑reliability	↑reliability
60	KISS, some info is just too lengthy	↑ Better targeted info	↑specificity of data	↑specific data driven by task "needs"	↑specific-task/info interaction	↑***info need*** driven change
62	Internet speed/mobile reception	↑reliability of mobile & Internet coverage	↑network connectivity thru ***reliability***	↑network reliability	↑reliability	↑reliability
63	see above (better mobile phone coverage so a smart phone works here - even a normal mobile phone to make and receive calls would be good! / Better and faster Internet coverage without drop outs and time outs. / a revived DAFWA with experienced staff as they are independent)	↑coverage; ↑Internet (speed/coverage?); ↑mobile phone support ↑gov info provision	↑coverage, Internet & mobility	↑mobile coverage (↑mobility & indep)	↑mobility ↑independence	↑independence/choice-making
66	Don't rely on just one source, every farmer is different in how they want to gain access to the information. Personally, I prefer both forms, a hard copy and Internet, as you can take a hard copy with you, but are limited with the Internet.	↑variety of information sources to deliver information ↑use of APPS that facilitate interaction	Internet & mobility	↑mobility ↑independence	↑mobility ↑independence	↑independence/choice-making
68	The more independent the source of information the more credible. It is very important that the people reporting the information have a good agricultural knowledge.	↑Trusted sources of information ↑Specialty in agricultural area	↑independence	↑Specific & relevant information to locals	↑reliability/trust	↑reliability/ trust of sources
70	Useful, relevant, seasonal, timely	Better targeted info/data	↑specificity of data	↑specific application of specific data to farmer needs	↑targeting farmer info needs (data and timing)	•info relevancy •info currency
72	Need to work on how to help farmers	↑interaction	↑local (farmer)	↑direct connectivity	↑Bottom-up	↑***info need***

	uptake new agricultural research technology, very poor	between farmers & researchers ↑use of APPS that facilitate interaction	driven interaction	between farmers & researchers ↑farmers drive change	business model	driven change ↑Bottom-up model
73	Assisted with appropriate information reliant to the decision	Better targeted info/data through closer networks (sys-to-local)	↑network connectivity (local & system) ↑specificity of data	↑ interaction between local environ & sys environ ↑farmer (local) input	↑relevancy ↑farmer (local) input (Bottom up approach)	↑CoP ↑Bottom-up business model
75	Not my province	?	?	?	?	?
76	More disinteresting, unbiased information. An organisation funded by a fertiliser company, for instance, will raise a degree of suspicion about his/her motives. Same for researchers funded by chemical companies	↑Trusted sources of information ↑Specialty in agricultural area	↑independence	↑Specific & relevant information to locals	↑reliability/trust	↑reliability/ trust of sources
78	Provide more on-ground support to assist with adoption. / Information providers need to follow up their work and not leave it in on article ie, understand the issues the farmer is having with the decisions /	↑interaction between farmers & researchers ↑use of APPS that facilitate interaction	↑local (farmer) driven interaction	↑direct connectivity between farmers & researchers ↑farmers drive change	↑Bottom-up business model	↑***info need*** driven change ↑Bottom-up model
79	Brief information- quick explanations / Easy to understand language / Email / Mobile friendly /	↑ Better targeted info ↑use of APPS that facilitate interaction	↑specificity of data	↑specific data driven by task "needs"	↑specific-task/info interaction	↑***info need*** driven change
80	Local and district relevance	↑Trusted sources of information ↑ Better targeted info	↑independence	↑Specific & relevant information to locals	↑reliability/trust	↑reliability/ trust of sources
83	Have a number of ways. Email, phone through text, Facebook, number of visual sites through field days, trial sites, membership to a number of Ag groups	↑variety of information sources to deliver information ↑use of APPS that facilitate interaction ↑social media ↑Networking "GG"	Internet & mobility ↑interaction	↑mobility ↑independence	↑mobility ↑independence	↑independence/choice-making ↑info networks (local info networks; system info networks) ↑CoP

Appendix E: Definition of terms

To guide the reader to understand the concepts within the outline of this study, the following terms are defined:

Agriculture: —Agriculture relates to both the traditional activities of agriculture i.e. planting, harvesting, marketing, animal husbandry and the natural resources management activities associated with agricultural work i.e. water management, soil fertility, agro-forestry, fishery management" (TAEDWI, 2003).

Delivery: —the carrying and turning over of letters, goods, etc, to a designated recipient or recipients". (Dictionary.com, 2011)

Disseminate/Dissemination: —to spread or give out something, especially news, information, ideas, etc, to a lot of people" (Cambridge University Press, 2011)

Consultant: —A consultant is an experienced individual that is trained to analyse and advise a client in order to help the client make the best possible choices" (SearchITChannel. com, 2007).

Agricultural Extension Worker: "serves as an administrative leader and coordinator for formulating, developing, implementing and evaluating agricultural extension programmes as well as develop farmers in managing resources in the rural areas. He guides the extension education activities for farmers as groups or individuals towards the purposeful pursuance of given objectives within a particular situation by means of extension communication methods" (Khalil, Hassan, Ismail, Suandi, & Silong, 2008).

Framework: —a hypothetical description of a complex entity or process" (WordNet Search, 2011).

Stakeholder: —a person or group that has an investment, share, or interest in something, as a business or industry" (Dictionary.com, LLC (2001).

Statistical Package for Social Sciences (SPSS): SPSS for Windows is a comprehensive software package that is used for managing quantitative data and performing statistical analysis.