RURAL INDUSTRIES RESEARCH
& DEVELOPMENT CORPORATION

Farmers, Advisers & Researchers

Interacting on the Net

Piloting Internet delivery of Agricultural Production Systems Simulator Support

A report for the Rural Industries Research and Development Corporation

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Foreword

The aim of the project was to pilot cost-effective interactions via the internet that aided learning and decision making for farmers, their advisors, and scientists. These interactions were centred on soil monitoring and computer based crop simulation.

This publication describes an internet based approach which has demonstrated potential to provide timely, cost-effective interactions between researchers and remotely situated farmers.

Researchers at the Agricultural Production Systems Research Unit (APSRU) were puzzled as to why, after 15 years of R&D and the release of various products from a number of organisations, significant demand for Decision Support Systems (DSS) had not developed among farmers despite dramatic increases in computer ownership. Similar indifference of decision-makers toward DSS has been well documented in other fields, such as management and medicine.

In 1992, APSRU researchers set out to find out why, and started by asking the following question: 'Under what conditions, if any, could farmers come to value crop simulation as an aid to their management?' From seven years of research emerged an approach for relevant computer-aided decision support in the dryland grain-growing region of northern Australia.

But once effectiveness of this approach was established, it became evident that a major impediment to sustained delivery was access to the approach.

This project set out to invent, evaluate, and then pilot ways to use the internet to reduce the costs of delivering intensive interactions to dispersed and isolated farmers.

This report was developed from data collected over two years of joint research with farmers and their advisers; a planned process of evaluation; interviews with farmer, adviser, and researcher participants; and a review of current literature in relevant fields.

This project was funded from RIRDC Core Funds which are provided by the Federal Government and is an addition to RIRDC's diverse range of over 450 research publications, forms part of our Human Capital, Communications and Information Systems R&D program, which aims to enhance human capital and facilitate innovation in rural industries and communities.

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Peter Core
Managing Director
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We would like to acknowledge the patience and unflagging enthusiasm of our farmer and adviser partners as we, together, worked out the inevitable bugs on this frontier of our practice.

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Acronyms

APSIM:	Agricultural production systems simulator
APSRU:	Agricultural Production Systems Research Unit
DEC:	Distance Education Centre, University of Southern Queensland
DSS:	Decision support systems
FARMSCAPE:	Farmers, advisers, researchers, monitoring, simulation, communication, action, and participatory research
GUI:	Graphical user interface
ITU:	International Telecommunications Union
LAN:	Local area network
MCA:	Michael Castor and Associates
WIfAD:	What if analyses and discussion

Contents

Executive Summary

The aim of the project was to provide cost-effective interactions via the internet that aided learning and decision making for farmers, their advisors, and scientists. These interactions were centred on the potential value of soil monitoring and cropping system simulation to learning, planning, and decision making in dryland crop and soil management.

We used an action research approach to

- establish a working prototype for holding online discussions about shared content via the internet
- pilot online management discussions between researchers and farmers who have a shared history of rewarding and productive face-to-face discussions
- evaluate both the technology and the experience of participants in terms of effectiveness and efficiency.

Our approach involved using the internet to facilitate 'real-time' *interaction* between farmers, advisers and researchers; using a combination of 'shared' content via the internet and telephone-quality voice, supported by limited video acting as a social 'lubricant'.

This research demonstrates

- the practicality and efficiency of conducting such sessions online
- that online sessions are not only practical, but they were often *preferred* to meeting face-to-face, due to increased timeliness and reduced travel
- both specialist content providers (in this case researchers) and farmers highly valued the cost savings resulting from using the internet as a substitute for face-to-face interaction
- for such an approach to be valued by farmers, the content of such sessions must be viewed as highly *significant* to their management
- using crop simulation over the internet provides a way for remote farmers to conduct long-term 'virtual experiments' on their own properties using paddock specific data
- that such sessions are practical given current rural infrastructure limitations
- the internet has an important role to play in facilitating *interaction* between farmers and specialists around specific issues where time and/or distance are constraints
- Our experience suggests that farmers do not have the time and patience to make 'chat' a feasible means of communication. These 'what if' sessions require an information rich environment including graphs, interactive spreadsheets and simulation. A combination of audio, application sharing and video worked well.

Several important additional points:

- All software we trialed was readily available and reasonably inexpensive. The product we piloted most extensively, Microsoft's NetMeeting™, is available free of charge. Other software from a variety of vendors with comparable functionality typically costs less than $150.
- NetMeeting™ along with other software tested is standards based. An international consortium of communications manufacturers and providers, the International Telecommunications Union (ITU), has described a set of standards to ensure the compatibility of communications equipment and services. Most major internet conferencing products, and all software we tested, are based on either the ITU T.120 or H.323 standard for video, audio and data conferencing over packet

switched networks (eg the internet). This facilitates a high degree of interoperability between software from multiple vendors.

- Our experience suggests that for this approach to interaction to be valued by farmers, the content must be seen as sufficiently *significant* to their management. In order to ensure content significance, the composition of the session is negotiated beforehand. These sessions are held in response to farmer demand, whereby farmers actively request certain simulations in response to particular circumstances they face. This process facilitates joint design of content with farmer and adviser participants.

- Crop simulation provides a way for farmer participants to conduct 'virtual experiments' on their own farms, using their individual soil and weather data. APSRU have spent several years developing the Agricultural Production Systems sIMulator (APSIM). APSIM is a sophisticated PC based package that is able to simulate a variety of crops, in any specified soil for any specified climate. APSIM uses soil data, which can be collected by individual farmers, together with their rainfall records to simulate crops for their individual paddocks.

- APSIM provides a powerful capability for farmers to run 'virtual experiments' over time periods, and for a range of variables which may otherwise be impossible due to sheer cost and scale. For instance a farmer might typically ask 'What would have happened if I had planted on this or that date in the *previous* season?' This can then be compared to what actually happened in the previous season, as a way for the farmer to gain insight into their cropping system's performance. Farmers can ask 'what-if' questions to interrogate their system's performance. Our research demonstrates that farmers can value online: i) benchmarking; ii) scenario exploration; iii) tactical planning; or iv) yield forecasting.

1. Introduction

Dryland crop production is an important industry in northern Australia, but it is a hazardous enterprise due to an often dry and always highly uncertain climate. Substantial public funds are invested in scientific research to assist farmers in reducing risk in this industry, with much of this funding being invested in information technology based methods and tools. Early attempts used simulation models within decision support systems (eg Siratac and WHEATMAN). In spite of increased farmer computer ownership rates, decision support systems (DSS) have not been adopted (Hamilton *et al* 1991; Cook 1994).

The FARMSCAPE (Farmers, Advisers, Researchers, Monitoring, Simulation, Communicative Action, & Participatory Evaluation) project (McCown *et al* 1998) used intermediaries facilitating computer-aided discussion to ascertain whether causes of non-adoption were due to inappropriateness/infeasibility or barriers related to the technology. Research over several years has shown that simulation can indeed be highly valued by significant numbers of farmers if certain criteria are met, and this has generated the nucleus of a new agribusiness service for farmers in the northern region.

Central to the FARMSCAPE approach is a simulation-aided management discussion that has become known locally as a 'what if?' analysis and discussion. A 'what if' is a process whereby farmers, their advisers and researchers explore and discuss alternative management strategies aided by crop simulation. Simulation enables farmers to ask questions about their farming systems for which answers may not be otherwise available. For instance, farmers are able to ask questions such as 'what if I had planted on this date last season' or 'what if I had applied this amount of nitrogen on this date in the previous season' or 'what if I apply this amount of fertiliser for this date and that crop in the coming season'.

FARMSCAPE research has established three key principles for decision support in this farming system

1. Simulation is considered by farmers and advisers to be a valuable tool for certain planning and decision making activities.

2. The opportunity for discussion overcomes one of the fatal deficiencies of DSS software for farmers. Effective decision support is best described as dialectic, not prescription.

3. Meaningful simulation often requires the simulator to be specified for the problem locality—the paddock.

These three 'realities' have sobering implications for the efficient and affordable provision of a service. (The strategy of the widely distributed interactive DSS package included avoidance of *the intermediary* and *customisation*.) But if both are needed for success, then the internet offers attractive prospects for minimising costs. This premise is the foundation of this project.

1.1 Other Research in this Field

Our literature review focused on the subject of *interactive communication on the internet for scientific intervention in practice and learning*. We conducted a multi-disciplinary search of 'Current Contents' and pursued relevant electronic abstracts.

We can safely conclude that in agriculture, while there are abundant papers dealing with the 'internet', there is virtually no reference to 'interaction'. In contrast, the medical field is actively experimenting with interaction *via* the internet. The most promising progress in this field appears in the literature on internet based patient meetings, electronic support groups, 'knowledge exchange' *via* internet, internet support service for disease self-management, among others.

Our original intention was to look for ways to collaborate with the then well established Farmwide program. We agreed to explore the potential for joint activities where there was mutual benefit. A number of interactions were undertaken during the course of the project in preparation for a joint online 'chat' session around matters relating to this RIRDC project. While we share a common interest with Farmwide in 'interaction', FARMSCAPE engages in directed, focussed communication activities as opposed to Farmwide's broad-based approach.

2. Objectives

The specific objectives for this project were as follows

- Design and establish a web site for use by the research team and the Distance Education Centre (DEC - based at the University of Southern Queensland). This provides an internet-based project management facility and a chance to test our systems before deploying them to a broader group including farmers and advisers.

- Design and build a web site to facilitate interaction between farmers, advisers, and researchers. This will provide all services related to interactions with farmers and their advisers including video conferencing and application sharing (using NetMeeting™), as well as asynchronous web based support and communication.

- Design and build an online 'what if' forum to facilitate asynchronous interactions between project participants. This is to enable participants to leave messages to be answered by other participants at a later point.

- Design and build a task specific multimedia instructional application to support and stimulate farmer learning and interaction.

- Evaluate and report.

3. Methodology

The knowledge this project sets out to create concerns *procedures* for using the internet as a means for farmers, advisers, and researchers to interact. A methodology that suits inquiry concerning questions of '*what is the best way to do…*' is known as action research.

3.1 Framework

The central idea of action research is the formalisation of learning by experience, and this is often depicted as a learning cycle with stages of plan, act, observe, and reflect (Figure 1). But the distinction between mere action learning and action research is that in the latter, in addition to the learning at the action level, there is learning at a second 'professional' level that concerns the *inquiry process*. At the action level in the planning stage, the practical problem is assessed and innovations that may improve the situation considered and selected. At the process level, additional plans are made by the professional researchers that might enable the experience to be captured in a 'theory' which relates action, consequences, and the environmental circumstances. *Implementation* involves participating in the planned action (with the professional's eye on documentation of process). *Documentation* includes capturing the process and outcomes guided by the structure of data (mainly qualitative) set out during the planning phase. *Reflection/interpretation* at the action level is evaluation by all the participants (and documented by the professional participants) of the action in terms of the outcomes and the original problem. At the process level, the research team discusses and interprets the data, develops 'theory', and relates theory to practice.

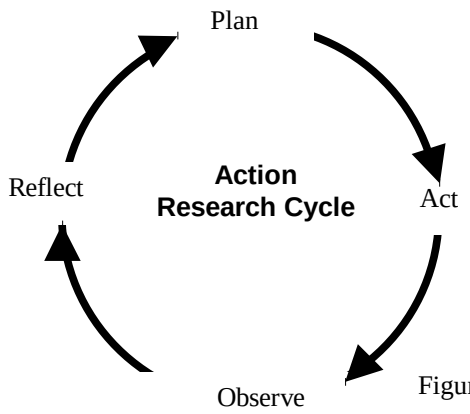

Figure 1

As an aid to implementing this approach, we developed an online session planning and reporting framework which is outlined in Appendix 1.

3.2 Project Methodology

Applying this concept, the elements of the methodology developed and used in this project were

1. Establish a working prototype for holding online discussions about content shared online via the internet.
2. Work within existing FARMSCAPE activities to pilot online management discussions between researchers and farmers who have a shared history of rewarding and productive face-to-face discussions.
3. Evaluate both the technology and the experiences of participants in terms of efficiency and effectiveness.
   Enter Step 1 of the next interaction with a procedural plan modified by new learning from Step (3).

3.2.1 Prototyping the internet interactions technology

We established and tested a working prototype system for holding online discussions about content shared via the internet. This prototype was trialed by researchers and commercial advisers in order to: compare performance over a range of connection speeds; identify bottlenecks to performance; and to identify limitations of the various component parts (computers, cameras, microphones, software, etc). Online forums were also

established on the web server. Online forums are places on the web where people can 'leave and receive' messages for one another in a secure environment. In a sense they are analogous to e-mail, but operate in a 'pull' mode as opposed to e-mail's 'push' mode. A 'pull' mode requires the user to actively seek the information, ie by going to a web site, whereas 'push' mode often refers to information which is sent directly to a user without any specific action on their part.

To provide privacy for these interactions, a password based security system was established to prevent unauthorised access. This was done, not so much due to the nature of the material, which often was not highly sensitive, but rather to provide an environment where participants could interact freely without concern for others outside the group accessing these at a later stage.

3.2.2 Work with existing FARMSCAPE groups

The second stage involved working within existing groups and activities to pilot these online sessions. Approximately 20 farmers were involved in this process. The groups involved had a shared history of participating in simulation aided discussion sessions within the previous FARMSCAPE group of projects, so consequently had a well established appreciation of simulation as an aid to their management. We intentionally selected farmers who already had this appreciation in order to evaluate the degree and nature of change the delivery mechanism made to the interaction. The premise was that if it was not possible for farmers who highly valued such face-to-face sessions to value a mode of interaction via the internet, then enthusiasm of other farmers cannot be expected.

These sessions involved engaging farmers and their advisers in interactions centred on the outputs of the crop simulator APSIM. Simulation provides a way for farmers to investigate the performance of their farming systems, in ways which otherwise would be prohibitive due to time and cost. The use of simulation allows farmers to gain insight by conducting 'virtual' experiments on their own properties over extended periods for which rainfall records are available. The management activities in which Farmers have found simulation valuable are: (i) diagnosis of past experience using 'theoretical benchmarking', (ii) production decision making, (iii) marketing decision making, and (iv) evaluation of contemplated changes.

These farmers already valued simulation as an aid to management in these ways and were now looking to gain efficient and effective access.

3.2.3 Reflection and interpretation

Stage three involved evaluating: a) the technology; b) the experience of farmer/adviser participants; and c) the experience of researcher participants. Evaluating the technology consisted of documenting data such as internet connection speeds, specifications of computers involved, and performance of individual software functions including audio, video, and application sharing. The experience of farmer and adviser participants was documented in order to assess the degree to which they saw value in the approach, their experience with respect to content and representations of APSIM outputs, and their experience in using the internet for interaction. The role of researcher participants usually falls into one of two categories during these sessions: a) that of researchers acting in the role of 'commercial advisers' delivering a service to clients; and b) that of researchers investigating this approach as a feasible means of delivery. Evaluation of the researchers' experience is structured around this split. This third stage is the key to improved performance and gaining insight into the process.

4. Results

As we adopted an action research approach within this project, objectives were modified in light of progressive experience. To better reflect our learnings, and more helpfully discuss the results, we have provided a revised set of objectives for this project.

4.1 Original Objectives

- Design and establish a web site for use by the research team and the Distance Education Centre (DEC - based at the University of Southern Queensland). This provides an internet-based project management facility and a chance to test our systems before deploying them to a broader group including farmers and advisers.
- Design and build a web site to facilitate interaction between farmers, advisers, and researchers. This will provide all services related to interactions with farmers and their advisers including video conferencing and application sharing (using NetMeeting™), as well as asynchronous web based support and communication.
- Design and build an online 'what if' forum to facilitate asynchronous interactions between project participants. This is to enable participants to leave messages to be answered by other participants at a later point.
- Design and build a task specific multimedia instructional application to support and stimulate farmer learning and interaction.
- Evaluate and report.

Design and establish a web site for use by the research team and the Distance Education Centre (DEC based at the University of Southern Queensland). This provides an internet-based project management facility and a chance to test our systems before deploying them to a broader group including farmers and advisers.

Accomplishing this objective involved setting up a web site that could be accessed by all project participants, but was protected from the general public. This provided a secure environment to develop applications before later deployment. This developmental site had several functions including: i) to provide a pilot site for researchers to develop and test approaches to interaction; ii) to develop materials to inform and stimulate thinking in farmer participants; and iii) to provide a site to facilitate synchronous and asynchronous interactions between project participants.

Design and build a web site to facilitate interaction between farmers, advisers and researchers. This will provide all services related to interactions with farmers and their advisers including video conferencing and application sharing (using NetMeeting™), as well as asynchronous web based support and communication.

A second web site was on the 'FARMSCAPE online' web server to host a number of online discussion forums (asynchronous interaction) and to provide a 'meeting place' for participants interacting via NetMeeting™. Microsoft FrontPage™ was installed to provide a tool to aid forum creation and management. FrontPage™ has important advantages in its ease of use, compatibility with a range of other software, and its ability to design database driven web pages. However, it also suffers weaknesses, in its non-standard graphical user interface (GUI), and the limited degree to which automated functions can be manually overridden.
Integral to online multimedia conferencing (synchronous interaction) using NetMeeting™ is an 'ils' server (internet locator server). The function of an 'ils' is to allow parties to locate one another and subsequently connect. The server acts like a telephone exchange, with the added feature of being able to see the names of people connected, whether they have a video camera, and audio conferencing facilities.

Initially the project team trialed a public 'ils'. Frequently there were more than 200 participants using the server at any point in time. Trials with the public server highlighted numerous problems including: difficulty in connecting; unreliable communication once connected; lack of privacy, with frequent interruptions from non-invited guests; and dependency on external system administrators for stability of the system. We had no control over when or if the server might or might not be operational. To resolve these constraints, an 'ils' server was installed in Toowoomba for use by project participants only.

Design and build an online 'what if' forum to facilitate asynchronous interactions between project participants. This is to enable participants to leave messages to be answered by other participants at a later point.

4.1.1 Sharing and discussing experiences in a delayed mode (asynchronous internet forum)

We established an online forum where participants could leave and read messages between sessions. Forums allow participants to do this in their own time, since they don't require those communicating to be online simultaneously. We piloted this mode initially with advisers on the premise that if this mode did not suit advisers, it would not suit farmers. Response was very low. This may have been for several reasons, including convenience of access compared with other asynchronous modes (eg e-mail) and the fact that interactions tended to be around specific cropping events, were time critical, and were intensive in their nature.

Design and build a task specific multimedia instructional application to support and stimulate farmer learning and interaction.

4.1.2 Online guide to best practice in soil monitoring

An online multimedia guide to best practice in soil monitoring was developed and deployed to the project web site. This is essentially a task specific multimedia application which is designed to aid farmers in their use of soil monitoring for nitrogen and water. It is the most comprehensive online soil resource designed for farmers, currently available in Australia.

The guide consists of over 100 pages of detailed explanation, diagrams and calculation tables tightly centred around the practical use of soil sampling for practical farm management. This online resource is based on the book, 'Soil Matters: monitoring soil water and nutrients in dryland farming', by APSRU researcher Neal Dalgliesh and CSIRO research fellow Mike Foale. There is strong evidence, as measured by web site hit rates and generated inquiries, that there has been substantial interest in this online guide from a range of people including farmers and overseas researchers. Web site hits on the FARMSCAPE server, as measured by the Microsoft Server software, were running at approximately 3000 hits / month over the last 3 months of the project. When this was broken down, approximately 23% or 690 hits / month went to soil matters online.

4.2 Additional Objectives

- Design a working prototype for holding synchronous online discussions between farmers, advisers, and researchers about relevant management issues.
- Publish a regular online newsletter to inform project participants and a wider group of stakeholders on project progress and activities.
- Work with a number of farmer groups to pilot synchronous online management discussions between researchers and farmers who have a shared history of rewarding and productive face-to-face discussions.
- Evaluate both the technology and the experience of participants in terms of efficiency and effectiveness.

Design a working prototype for holding synchronous online discussions between farmers, advisers, and researchers about relevant management issues.

We trialed two modes of synchronous interaction: i) synchronous chat sessions; and ii) synchronous internet meetings. The balance of our activities was strongly influenced by some early realisations. On the one hand, synchronous internet meetings with telephone-like audio exchange and shared content were readily achievable if a second telephone line was available to enable a telephone call to substitute for poor internet audio. On the other hand, our experience suggests that farmers do not have the time (and patience) or the typing speeds to make 'chat' a feasible means of communication. The 'multi-threaded' nature of chat sessions often proved difficult when many participants were active.

For the purposes of focused interactions on significant farm management issues, *only* audio enabled synchronous internet meetings seemed promising. The types of issues that are often dealt with in 'what if' sessions require timely, media rich (ie contain graphs, interactive spreadsheets, simulation), and highly interactive communication. Questions are often posed that require the simulator to be run, or gross margin spreadsheets to be adjusted and recalculated immediately.

4.2.1 Online multimedia conferencing software

Online multimedia conferencing allows farmers, their advisers, and researchers to be dispersed geographically yet share computer applications, communicate using voice and video, and a common whiteboard environment. We could not find information from several reported comparisons of performance that suggested any package was superior to NetMeeting™ in the functions we required (shared computer applications, audio, and video). In addition to this, NetMeeting™ is currently available free of charge (www.microsoft.com/netmeeting)

Microsoft NetMeeting™ is a Windows 95/98/NT/2000 application that allows two or more computers to connect via a local area network (LAN) or the internet. NetMeeting™ allows 'point-to-point' video and voice, and 'multi-point' data conferencing.

'Point-to-point' audio / video means that only two instances of NetMeeting™ can communicate using voice / video at any one time. 'Multi-point' is the ability for three or more instances of NetMeeting™ to share data (ie application sharing, whiteboard and chat). Essentially this means that only two 'households' can communicate at one time with using NetMeeting™ using audio/video, where many 'households' can communicate using NetMeeting's™ data conferencing functions.

During our sessions farmers typically participate from their own homes (or a neighbours). These sessions involve displaying simulation and soil coring results, in the form of graphs, on participant farmers screens. These screens are shared, and a discussion takes place based on the results. Because the graphs are based on farmer's actual data, they are able to relate the results to their experience.

Voice and video typically consume the most bandwidth, while application sharing consumes much less. This means that even where bandwidth is restricted, sharing of content is rarely affected, and audio can be provided with a normal telephone call. Sessions have been conducted successfully over line speeds as low as 14.4kb/s with NetMeeting™ application sharing and a telephone call using speaker-phones.

At present, there are two ways to circumvent NetMeeting's™ restriction of audio and video to point-to-point. One is to use a multi-point, 'conference', telephone call. Another is by using WhitePine Software's CuSeeMe-Pro™. CUSeeMe-Pro™ offers multi-point voice, video, and chat, and piggybacks on NetMeeting™ to provide application sharing and whiteboard facilities. But this requires rather expensive (approx. $13,000) server software called MeetingPoint™ to enable its multi-point features. MeetingPoint™ also provides sophisticated bandwidth management facilities to make multi-point video-conferences feasible with only limited bandwidth. We undertook limited trials of CUSeeMe-Pro™ together with the Australian distributors. These trials revealed a degree of complexity, and issues with video and audio quality. As this software only became readily available in the latter stages of the project, we were somewhat restricted as to the tests we could carry out. Further tests will continue.

Some companies offer packages that bundle software with a camera for less than $250 (eg CuSeeMe Pro). The camera we trialed most extensively was the Kodak DV320 USB, which typically retails for around $300.

NetMeeting™, along with other software we tested, is standards based. An international consortium of communications manufacturers and providers, the International Telecommunications Union (ITU), has described a set of standards to ensure the compatibility of communications equipment and services. Most major internet conferencing products, and all software we tested, are based on either the ITU T.120 or H.323 standard for video, audio, and data conferencing over packet switched networks (eg the internet). This facilitates a high degree of interoperability between software from multiple vendors.

4.2.2 Content significance

Our experience shows that for enthusiastic involvement of farmers and advisers, the content must be seen as sufficiently *significant* to management of their farm. In order to ensure content significance, the composition of the session is negotiated beforehand. These sessions are held in response to farmer demand, whereby farmers

actively request certain simulations in response to particular circumstances they face. This process facilitates joint design of content with farmer and adviser participants.

Publish a regular online newsletter to inform project participants and a wider group of stakeholders of project progress and activities.

We published a quarterly online newsletter, 'FARMSCAPE Insights', which is designed to keep project stakeholders informed of current activities and to stimulate project discussion. This newsletter includes interviews with project participants, photographs, a glossary section, and technical articles.

Work with a number of farmer groups to pilot synchronous online management discussions between researchers and farmers who have a shared history of rewarding and productive face-to-face discussions.

A number of farmer groups were selected from groups who were already participating in a range of FARMSCAPE based activities, and who previously had a degree of exposure to face-to-face simulation aided management discussions. These groups were studied intensively to produce three case studies, each of which were chosen to illustrate our development in understanding key aspects of this approach.

The first case study was based on a group of farmers from Bongeen on the Darling Downs, Queensland, and their use of APSIM to produce comparative gross margin analyses for a number of fertiliser rates and planting dates. The second case related to a commercial advisory firm based in Goondiwindi, Queensland. This case examined the degree to which commercial advisers see value in using this approach as part of their commercial operations. This case used APSIM in a tactical planning role, where a number of planting dates were evaluated for sorghum and cotton. The third case related to using APSIM to benchmark crops grown for the previous season around Jimbour, Queensland.

4.3 Case 1

Activity: Gross Margin Analysis
Place: Bongeen, Darling Downs, QLD.
Participants: Farmer group, researchers

Background

A group of four farmers, located at Bongeen on the central Darling Downs, have been exposed to and currently see value in simulation aided management discussions to the degree that they regularly request such sessions before making planting decisions. To provide these sessions, researchers need to travel about four hours in total, and spend another two to three hours for the session itself. This time represents a cost, in researchers time, which makes it prohibitive to conduct these sessions in a sustainable way. This group met several important criteria: i) they were genuinely remote; ii) they had computers with modems; and iii) they had access to telephone lines of a reasonable quality.

Researchers were connected to the internet via 128kb/s LAN connections, while the farmer group used a 56kb/s modem link with the actual connection speed ranging between 14kb/s and 40kb/s. Researchers typically used Pentium 266Mhz based computers or faster which are required to run APSIM, while the farmer group used a 300 Mhz Celeron based computer. All participants communicated over the internet using Microsoft's NetMeeting™ software.

Results from this case study suggest that it is practical to interact via NetMeeting™ using application sharing (with no audio or video enabled), at connection speeds as low as 14kb/s.

Aims

The research aim of this case study was to evaluate the *technical* and *social* feasibility and solve any problems of conducting a 'what if' with participants in separate physical locations, using a combination of the internet and a telephone conference call to mediate communication. The farmers' stated aims were to evaluate alternative planting dates for a number of different crops for the summer season.

Session content

Before the session, an APSRU researcher negotiated with the farmer issues they indicated as important. The farmers wanted to know likely yields for two crops for several planting dates. The researcher was then able to gather data required in order to specify APSIM to run effectively: i) farmers' weather data; and ii) farmers' soil data. To increase the efficiency of the session, key simulations were run in advance.

Two researchers were stationed at APSRU in Toowoomba, one running APSIM, with another providing technical support. A third researcher was present with the farmer group at Bongeen to provide technical assistance and to evaluate the session.

When the simulator was run by the researcher in Toowoomba, the outputs were simultaneously displayed on the computer screens of the farmer group using the 'application sharing' feature of NetMeeting™.

Using a Bongeen soil and local weather data, an APSRU researcher in Toowoomba ran a number of simulations based on sowing date (1 Oct, 21 Oct and 15 Nov) for mungbeans (figure 2) and (1 Oct and 30 Dec) for cotton (figure 3). This was done to evaluate the effect of sowing date with the current SOI phase for this season. A comparison of a consistently positive phase in October with all other phases had been graphed and summarized using a pre-prepared spreadsheet. This provided the initial stimulus for discussions, before turning to gross margins. A mungbean/cotton comparison was selected and graphed. Due to the flexible nature of APSIM, further simulations and gross margin analysis were done in 'real time' during the meeting in response to farmer questions.

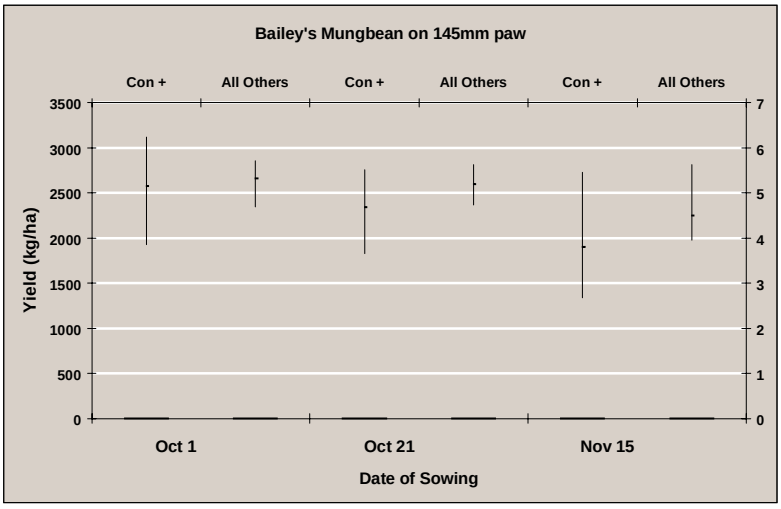

Figure 2

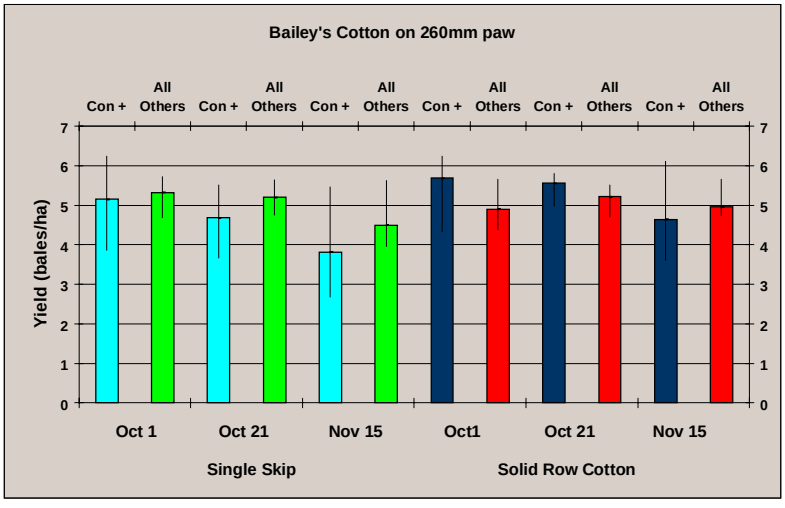

Figure 3

Research methodology
An *experimental* action research approach was used here, with the focus at this early stage on establishing the criteria for feasibility for such sessions. Our action research approach operates simultaneously on two levels: i) intervention to solve a farmers problem; and ii) intervention as a research activity. While both these levels were pursued, the focus during this stage of research was on the processes as a research intervention, rather than the content of the farmers' particular problem. The prerequisite for successful future sessions would be the effective use of the internet for such interactions.

Evaluation results
As is seen below, participants indicated in several instances that this mode of interaction was 'just like having somebody here'. The following is a selection of comments drawn from the evaluation process:

Farmer data:

> 'The output from the session was like having the team in the kitchen.'
>
> 'There isn't a lot of negative in it. It would be different if you had 6 or 7 people sitting around a table.'
>
> 'I find it is just the same as sitting at the table with researchers here…'
>
> 'When we get better at running NetMeeting™ it would be more efficient, once we get the hang of it would be just like sitting at the table talking, as long as it doesn't get complicated on this end in using it.'
>
> 'Once we've got the hang of it, it's virtually the same as sitting at the table with the researchers out here using it.'
>
> 'By what we're talking about there at the end (in season sessions with updated rainfall) we could call back later at any time during the season, to find out if we should market a bit more…fantastic.'
>
> 'Time wise you can sit down for half an hour and do it, you can email the information you are going to require so it's all there and you can run through it. When a researcher comes out here each one has got its own thing and he needs to do it all up and that takes time, whereas now we can work it out beforehand what we want, email it through, its ready and there.'
>
> 'It's obviously possible to have a greater number of small contacts with APSRU. It's far more timely, it's a lot easier to coordinate.'
>
> 'Figuring can be more exact because we have had the opportunity to give them the information beforehand and have it ready.'
>
> 'Plus come to budgeting time (I have an annual review with the bank) I have been using it as a tool to predict what potential the crop might do for the year. My bank fellas love it… they'd like to see it.'

Discussion/interpretation
This sessions clearly established that not only was it technically and socially possible to hold interactions of this sort via the internet, but some farmers actually *preferred* this mode due to the increased timeliness and potential increase in frequency (due to decreased costs). There was an emphasis on it being 'just *like* having researchers here'. This is an important point. Interacting in this mode *is* in many respects just like having the other party present, except that the audio quality is not as good, and the visual range of participants is extremely restricted (even if using a camera). The content of the interaction, ie the shared applications are still evident and suffer no degradation, apart from a short delay in updating on slower connection speeds.

Travel costs were removed entirely and the session itself tended to be shorter and more highly focused. The session was more targeted with less 'non-critical' social interaction. When these are conducted face-to-face, there is a degree of interaction which often does not relate directly to the issues discussed, but nevertheless constitute important 'scene setting' and 'relationship building' activities. Evaluation revealed that participants

still value this part of the face-to-face component, but suggested that '…we could still get together a couple of times a year to catch up.'

The total time for interacting in an online mode was about 1.5 hours or 4.5 hours less than is required in total (including travel) in a face-to-face mode. Significantly, no 'negatives' of the online meeting were voiced in the evaluation.

4.4 Case 2

Activity: Tactical Planning
Place: Goondiwindi, QLD.
Participants: Michael Castor & Associates, two APSRU researchers.

Background
Michael Castor is owner and manager of Goondiwindi-based farm management consultancy, Michael Castor and Associates (MCA). The firm employs three full time staff, in addition to Michael and wife Jemma. MCA provides consultancy services to a number of large properties surrounding Goondiwindi. They agreed to trial this approach with us in order to evaluate its feasibility for supporting their clients, and APSRU supporting MCA in doing so. Goondiwindi is some 200km west of Toowoomba, which places real constraints on the frequency of face-to- face interactions.

Initial collaboration involved APSRU providing simulation outputs to MCA in response to issues they (and their clients) found value in exploring. Demand for simulation outputs has grown quickly, from both MCA and other consulting firms.

This case study focuses on providing timely APSIM support to agribusiness, to support them in their interactions with their clients around these matters.

Evaluation of previous internet based meetings have demonstrated the practicality of this technology, within the constraints of limited bandwidth and computing power. Once this was established, it then became necessary to examine the extent the social interaction was modified and to evaluate how this affected the completion of specific outcomes. This session was therefore designed to implement and evaluate interactions centred on APSIM simulations using NetMeeting™, in a commercial environment, with the aim of completing specific outcomes. From a research perspective we were attempting to gauge whether the degree of social modification to the interaction would further prohibit its use.

Aims
Research aims for this case were to evaluate the degree of modification that occurred to the social interaction, between a face-to-face mode and an online mode. Our agribusiness collaborator's aims included: i) exploring sorghum planting opportunities around Goondiwindi; including early, late and standard varieties; and ii) the potential for growing cotton at Mungindi, northern NSW. These scenarios were requested by MCA in response to their clients' needs.

Session content
This session was conducted point-to-point between one APSRU researcher in Toowoomba, and two MCA advisers in Goondiwindi. The ASPRU researcher had prepared a number of simulations before the session in response to a discussion some days before. These simulations are usually graphed as probabilities (based on simulations for a large number of years using historical daily weather data) for achieving each of a range of yields. Often the current SOI value is used to identify those years which had the same SOI value at a

comparable date, and a second probability distribution graphed that more narrowly matches current conditions.
The half-hour prior to the session was used to provide the primary consultant brief 'refresher' training in the use of NetMeeting™. The advisers involved had been exposed briefly to NetMeeting™ via a previous event. This was the first event in which MCA attempted to use NetMeeting™ as a tool in the completion of daily commercial activities.

Research methodology
As in the first case we have used an *experimental* action research approach. The focus is still on attempting to evaluate the performance of the technology in relation to purposeful human-to-human interaction mediated by the internet.

Evaluation results
Evaluation was undertaken via four processes during this intervention: i) pre-session interview; ii) notes and observations during the session; iii) audio recording; and iv) a post session interview.

The interviews were broadly based on a series of pre-defined topics. The actual structure of the session developed in response to the evolutionary progression of the interaction.

The following is a representative sample of comments from MCA advisers, taken from the pre-session interview:

> I want to '…see how the sorghum thing comes up… and see how NetMeeting™ works'
> 'The boys were pretty impressed (with NetMeeting™) last time'
> 'If we are doing APSIM runs… you can help us without the travel'
> 'Faster way of learning for us rather than travelling'
> 'Fair few clients on the net, but they're not really using it for anything productive'
> 'Bloody good idea if it saves me driving'

As the sessions began, both researcher and adviser participants quickly acknowledged a two-second delay between completing a task and receiving the result at the other end. This initially resulted in a degree of disorientation, which had the effect of obstructing the interaction (similar to the delay of a bad international telephone call). However, both participants quickly adapted to this, to the extent that it was accepted as a natural characteristic of the interaction, and hence reduced as an obstruction.

Our experience with previous sessions indicated that a good working knowledge of NetMeeting™ was essential to ensure the smooth running of the session. The short orientation before the session appeared to have had the effect of facilitating this. Participants were less inclined to halt the session due to an inadequate understanding of NetMeeting™. This brought the focus firmly to the content, as opposed to the tools of the session.

The APSRU researcher presented two sets of Excel spreadsheets on early and late maturing sorghum varieties. Discussion ensued, which resulted in the researcher running APSIM for a medium maturity type.

The APSIM GUI contains a large graphic image as part of the display. This does not present a problem running APSIM offline, however when the interaction is moved to an online mode the graphic consumes substantial bandwidth. Tests run previously indicated that it was possible to remove the graphic, and once this had been done speed of transferring the GUI data increased dramatically.

An MCA adviser remarked: 'The connection speed's not too bad.' The APSRU researcher proffered: 'It's still reasonably quick isn't it.' Measuring the actual connection speed, which was 23kb/s, supports these anecdotal comments, with MCA's modem being the constraint. Both participants saw this speed as adequate for this type of interaction. NetMeeting™ quickly became a transparent tool to which participants were largely oblivious. The simulation outputs were clearly the focus of the interaction, rather than the focus being on the technology itself. The technology presented such a little barrier that over time participants appeared largely oblivious to its presence, much like use of a telephone.

To our surprise, both participants indicated NetMeeting™ was *preferred* to meeting face-to-face for the purposes of this interaction. The two primary reasons cited for this were: i) increased efficiency of interaction (ie removal

of travel time); and ii) convenience of low participant to computer hardware ratio (typically 1–2 participants per computer monitor, as opposed to up to five in a traditional face-to face mode.) Consequently a session that would typically take a day was reduced to a single two-hour consultation. Evaluation revealed that after this experience, MCA would actively explore using NetMeeting™ in interactions with clients.

The post-session interview with the MCA advisers revealed that the objectives had been met; that this mode of interaction saves substantial time and may be superior to meeting face-to-face for these types of interactions. The advisers suggested that the time saving might in fact encourage further interaction, as the associated cost is less. There was also indication of an initial period of 'adaptation' to using NetMeeting™, with a delay in response causing a degree of confusion. As indicated above, this was quickly removed as a barrier to communication.

The following is a summary of the main points made by an MCA adviser:

> 'Yes we achieved what we wanted to'
> 'Just like having someone here'
> 'Scrolling up and down gets a bit confusing'
> 'Big time saving'
> 'The time saving might stimulate us to get more involved'
> 'This would otherwise take the best part of a day'
> 'This is better than face-to-face, considering you normally have to fit three or more people around the computer [the researcher] is using… and the time saving'
> 'Why would we want to pay [extra for face-to-face] when NetMeeting™ is better than face to face'
> 'Yes I would seriously consider using this technology with my clients'

Discussion/interpretation

The most important result from this case study was that using NetMeeting™ was seen by both researchers and commercial advisers to be an efficient and effective means of supporting them using APSIM.

It appeared that the limited bandwidth and computer power are not significant constraints to APSIM-centred interaction using NetMeeting™ (without audio and video features) and a telephone conference call for audio. This is significant in that many rural data speeds are restricted due to poor quality phone lines, analogue exchanges etc. Having said this however, the computer running APSIM must be high-powered to run long term scenarios in acceptably short periods of time.

The most surprising result for us was that NetMeeting™, in this instance, was actually *preferred* to meeting face-to-face for the purposes of these types of interactions.

This was an indication that the anomalous aspects of communication generated by using NetMeeting™ (ie delayed response etc) were not a serious problem to communication once participants had adapted.

4.5 Case 3

Activity: Benchmarking
Place: Jimbour, Darling Downs, QLD.
Participants: Jimbour farmer group, IAMA advisers, Landcare representative, APSRU researchers.

Background

A group of farmers from Jimbour has been involved in designing and conducting experiments together with IAMA (an agribusiness firm in Toowoomba) and APSRU from 1997–1999. The experiments were designed to examine practical ways to increase soil organic matter and water infiltration. Treatments were selected to cover a range of options including pure Lucerne and grass leys, mixed grass/lucerne leys, and feedlot manure.

Farmers from the Jimbour group have previously participated in simulation aided management discussions in a face-to-face mode, and were familiar with the process. This group however, had not attempted such discussions on the internet before this event.

Benchmarking is one of four primary uses for APSIM which have emerged from interactions with farmers. Briefly, benchmarking a crop involves diagnosing the performance of an actual past crop for which data was collected. APSIM is used to simulate the actual crop as well as possible performance under relevant, but hypothetical, variations in management and environment.

The case involved researchers taking on two distinct roles in the interaction: i) researchers sharing results of using APSIM to shed light on implications of an unusual cropping event on successive sessions; and ii) researchers acting in the role of 'consultants' delivering an APSIM based service.

One APSRU researcher planned to deliver a component of the session in the role of 'researcher acting as consultant'. To this end he prepared simulations for a range of planting dates for the previous summer season. Another researcher facilitated the second half of the session. Both researchers were located at ASPRU in Toowoomba and communicate via Microsoft NetMeeting™ with a farmer group at a property at Jimbour. We expected the group to include 8-12 farmers and one or two advisers. Due to the size of the group, the computer screens were projected, audio was facilitated using conference telephones at both ends, and video was sent from both ends.

Farmer Aims

The event negotiated with farmers comprised of two activities

- To discuss an analysis done by an APSRU researcher for the Jimbour group as decision support for planting a Maize crop, summer 1998/99. This comprised primarily of a benchmarking activity.
- Explanation of probable consequences of the unusually high quantity and quality of crop residues of a failed barley crop in winter 1998 in the experiment at the farm in question.

Research aims

- To evaluate the usefulness of interactions between farmers, their advisers and researchers using the internet in two modes: i) as researchers reporting experimental results; and ii) as consultants discussing simulation outputs based on farmer data.

- To establish to what degree farmer participants valued simulation aided management discussions mediated by internet based multimedia collaboration software (NetMeeting™).

- To document farmers experience of interacting in an online mode, as contrasted with previous face-to-face interactions.

- To evaluate the extent to which conducting the interaction online alters the nature of the communication (as compared to a face-to-face session). What is lost, why is it lost, what are ways we could compensate for that?

Session content

The session started with a researcher presenting two sets of histograms. Each showed potential yield based on both half and full moisture profiles for a number of planting dates for the summer season 1998/99. These sets were proceeded with a typical summary graph indicating predicted yield with the 20, 50 and 80 percentiles marked. Farmers showed noticeably more interest in the summary graphs (figures 4 and 5), and in a number of instances actively requested these to be displayed.

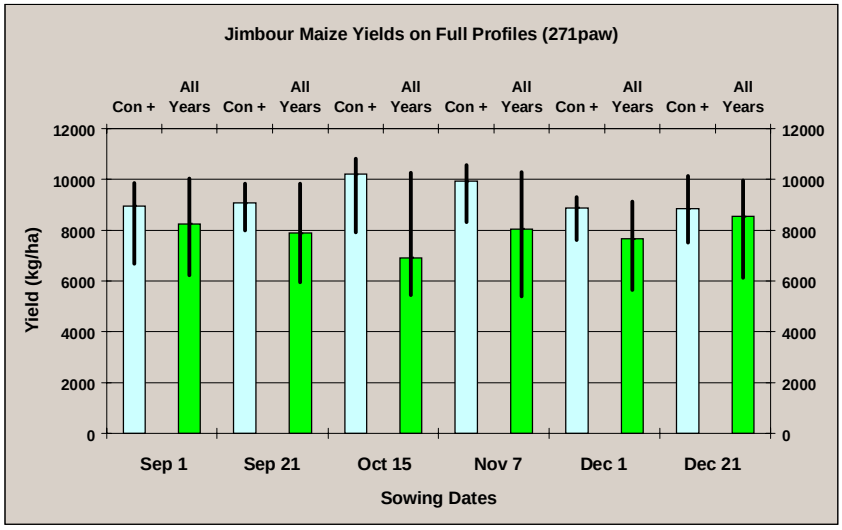

Figure 4

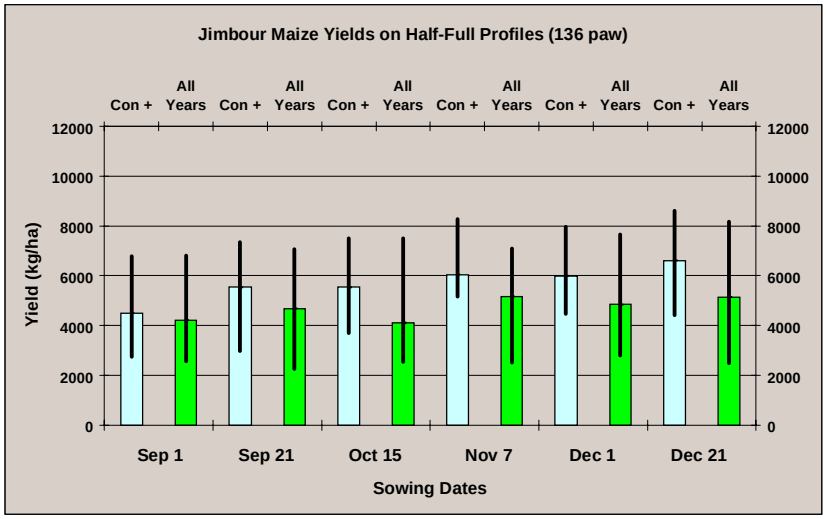

Figure 5

Another researcher then proceeded to discuss probable consequences of the unusually high quantity and quality of crop residues of a failed barley crop in winter 1998 in the experiment at one of the farmer's properties.

Research methodology

There were approximately 12 participants, including farmers and their advisers, present at Jimbour. A computer projector was used at the farmer group end, together with NetMeeting™ and a telephone conference call. Video cameras were set up at both the researchers and farmers end. This was the first time such a session had been conducted with a group of this size.

We again used case study methodology together with an action research paradigm during this intervention. We planned to use four data collection activities during this investigation: i) primary and secondary note taking during the session; ii) loosely structured evaluation involving farmer participants, held immediately after the event; iii) audio recording of the event; and iv) documentation of informal perceptions of researchers.

Evaluation
A range of evaluation was undertaken including note taking, audio recording and semi-structured group interviews. This was then followed up at a later time with individual interviews.

Discussion/interpretation
Both researchers indicated that video sent from the farmers' end was at best not useful and at worst a distraction. The reasons stated included: i) the video was too dark; ii) the image was unclear; and iii) there was no facility to move the video camera unobtrusively to show who was currently speaking. The video was seen as a poor substitute for being able to see the group of farmers face-to-face. One researcher stated in discussion: 'It was an unsatisfying experience because I couldn't get good feedback from the audience. I didn't know if they were going to sleep or not.'

This contributed to both researchers suggesting that it was very difficult to judge reactions of farmers in the group to the different content. This resulted in difficulty knowing *what* content to introduce, *when* to introduce it, and *how* long to talk about it. One researcher stated that the resulting effect was akin to being blind and attempting to conduct the session. All information displayed by the researchers was *relevant* (as the event was jointly negotiated beforehand with the farmers, however the researcher stated it was almost impossible to judge what content/representations farmers found *significant*. Information considered important in close social interactions such as these was often lost (ie body language and other subtle non-verbal queues).

This was the first session we conducted using this approach with a larger group (ie >5 people). The size of the group had several implications including: i) type of computer display required; ii) the intimacy of interaction; and iii) problematic telephone communication. With larger groups, a computer projector is used rather than a standard computer monitor. The degree of intimacy with the combination of larger groups and a computer projector was somewhat diminished. A conference telephone provides good audio for few participants in a concentrated area, however they do not perform as well with larger dispersed groups. It becomes a matter of having to hand the telephone around to individual participants in order to achieve a reasonable degree of clarity.

Currently relevance is ensured through joint design of content at a broad level by both farmers and researchers. This is usually done a week or so before the session, and usually consists of a phone call with one or more participating farmers. In a traditional face-to-face mode, the precise detail of the session is designed jointly in-action. Researcher facilitators are able to respond to participants in a dynamic and flexible way during the session, adjusting content and pace in response to farmer interest on-the-run. If participants appear fatigued or disinterested than remedial action can be quickly taken. However, for the reasons outlined above, during an online sessions researcher facilitators are constrained in their ability to respond in such a dynamic way. This is due largely to the lack of effective feadback from the farmer group as constrained by the poor video.

During the post-session reflection, several ways to improve the researcher facilitator's ability to effectively 'design in action' were suggested

- trial the best quality video currently available, with particular attention paid to lighting sources, visibility of group members, etc
- make potential topics/representations explicit at the beginning of the session and negotiate with farmer participants their preferences
- trial designating an informal facilitator among the farmer group. This person can subtly feed back important details to the researcher at the other end such as: the degree of interest in various types of information being presented; demand for other types of information; and judging and feeding back relevant social information about the group (ie when the group is looking tired, wanting a break, interested, etc). In a sense this 'farmer facilitator' could act as the 'eyes and ears' for the off-site researcher, feeding back important information that is not readily observable due to the poor quality video.

The video appeared to play a noticeable role in establishing a social setting for the researchers and the farmer group at the beginning of the session. In some sense this could be seen as a surrogate for 'shaking hands', saying hello, etc. After this however, the role of video quickly became secondary to the combination of shared content and audio. Where possible during this session, the video (from the researchers' end) was enabled to allow farmers to see who was speaking at any one time. In a general sense the farmer participants appeared to appreciate the presence of video when the content took the form of a presentation. With farmer interest quickly

shifting to the shared content on the screen, this raises the issue of graphic representations (ie the combination of text, graphs, images, etc displayed during the session).

5. Discussion of Results

5.1 Cost-Benefit Considerations of Internet Meetings

5.1.1 From farmers' standpoint

Farmer participants indicated virtually no loss in moving from a face-to-face mode to the internet meeting. In evaluating this, we asked: 'If the online session was free, how much would you be willing to pay for a face-to-face session?'. One farmer responded: 'Why would we pay for a face-to-face meeting when it's just as good online…there's virtually no difference between the two… and by having you guys back at the office means you have access to people and resources you might not if you were out here.' Another farmer added: 'You get access to a range of experts/information that may not be available on the day'. When queried further, this farmer then referred to a previous face-to-face session where he indicated this would have been useful.

Despite the consternation often expressed about the state of rural telecommunications, our findings indicate that it is feasible, cost effective, and practical to conduct internet meetings with limited bandwidth, often with the use of a telephone to substitute audio transmission.

5.1.2 From standpoint of scientist-facilitator using APSIM

The challenge of conducting sessions online is that presenter/facilitators are limited in their ability to 'read' the remote audience as the session progresses. The move from face-to-face to online entails a very serious loss of feedback from the farmers to the presenter/facilitator. Although quite adequate for 'one-on-one' interaction, both audio and video technology are inadequate to enable the online presenter to 'scan' the 'signals' being emitted by individuals in a group that would indicate puzzlement, boredom, disagreement, etc.

In order to compensate for this loss, use of a 'planted' person to be the eyes and ears for the facilitator has recently been trialed. Although successful to some degree, it is clear that it is a skillful role, and the skill will take time to acquire. Whether communication between this person and the facilitator is best done within the audio exchange with the group or on a separate telephone connection, eg a mobile, is not yet clear.

There are three types of data that potentially consume bandwidth when using NetMeeting™: audio, video, and application interfaces. Our results reveal which data is most valued for different types of interactions. The matrix below matches types of interactions with data transfer (Table 1). NetMeeting™ is capable of transmitting a fourth type of data using 'chat boxes' (not shown here); however its use has been discounted for several reasons. It requires that users are proficient typists, and must adapt to communicating in a vastly different way to typical verbal interactions. Our experience suggests that both of these present significant barriers to communication for novice and experienced users alike. It is an example of users adapting to technology rather than users adapting technology for their purposes.

Table 1

Type of Interaction	Audio (point-to-point)	Audio: Telephone (multi-point)	Video	Application sharing
Adviser interacting with client	X			X
'what if' (>2 sites)		X		X

The aim was to use the most 'data efficient' or parsimonious way to communicate for a specific type of interaction. We used finite bandwidth, most commonly 28.8kbs, with a mix of data that provided the highest proportion of relevant information for a particular type of interaction. For example, some characteristics of a 'what if' include: i) commonly held between people who are well acquainted; ii) focus of discussion is APSIM inputs and outputs; iii) potentially several sites connected at low bandwidth.

A video image transmits large volumes of information about fairly specific things (eg non-verbal, situational, environment, contextual). For example, our trials suggest that this type of information is largely irrelevant during 'what if's, where participants are acquainted and the focus of interest is APSIM outputs. Our trials suggest that during these sessions, best use is made of limited bandwidth by interface, rather than video data. We can transfer audio data transmission from a limited 28kbs internet connection to the public telephone network by using a telephone call to substitute for NetMeeting™ audio. This further frees bandwidth to speed transmission of application interface data. Some characteristics of different types of data transfer for online interactions are shown below (Table 2).

Table 2

	Video	Audio	Application sharing
Characteristics	• coupled with audio, simulates physical presence of participants • highly bandwidth dependant: only feasible on high capacity lines (>28kbs) • adds an additional 'non-verbal human dimension' to interactions • useful for interactions where the 'non-verbal human dimension' is important (eg administrative or project issues) • limited to point-to-point	• minimum requirement for all types of interaction • moderately bandwidth dependant: feasible on low capacity lines (>14kbs) • limited to point-to-point with internet based applications • multipoint through public telephone network • unsuitable where non-verbal communication is important	• multi-point: reliable for <6 participants on medium to low bandwidth lines (ie 14bps – 28bps) • useful for interactions centred on application outputs (eg APSIM, Excel) • needs to be augmented by audio to be given meaning, context • adds richness to audio communication

Evaluation has indicated that two commercial agribusiness firms IAMA Seed and Grain and Michael Castor and Associates currently believe the technology is sufficiently mature for interactions with their clients. Their focus is now on training field agronomists in its use to facilitate such events.

5.2 Cost Analysis

5.2.1 Option 1: NetMeeting™ 'point-to-point' (using NetMeeting™ audio)

Component	Cost
Pentium class computer & modem (f)	$2000 (variable)
Internet connection (f)	variable

Standard PC microphone (f)	$29 (often included with computer)
Kodak DC320 webcam (f)	$329
NetMeeting™ software (f)	free
NetMeeting™ ILS server software (r)	free

5.2.2 Option 2: NetMeeting™ 'multi-point' (using speaker-phone audio)

Component	Cost
Pentium class computer & modem (f)	$2000 (variable)
Internet connection (f)	variable
Panasonic speaker-phone (f)	$129
Second phone / fax line	variable
NetMeeting™ software (f)	free
NetMeeting™ ILS server software	free

5.2.2 Option 3: CUSeeMe™ & MeetingPoint™ server 'multi-point'

Component	Cost
Pentium class computer & modem (f)	$2000 (variable)
Internet connection (f)	variable
NetMeeting™ software (f)	free
CUSeeMe-Pro™ software (f)	$299 / copy (including webcam)
MeetingPoint™ server software (r)	$13,000 (approx.)
Server to run MeetingPoint software (r)	$3,000

f = equipment / costs which need to be bourn by farmers to participate in such sessions
r = equipment / costs which need to be bourn by researchers or another commercial service provider in order to hold such sessions.

5.2.3 Evaluation process

Evaluation has been an integral part of each component of the project methodology. We have formalised the *document* and *reflection* stages to the action research loop to constitute the formal evaluation component. Several evaluation instruments were used during the course of the project. The primary data collection methods included session entry questionaries, exit questionaries, direct observation video and audio recordings of both sessions and participants responses. Individual participants were often interviewed separately, with their responses video taped for later analysis.

The evaluation process provided important structure to both data collection and reporting processes. This added an important dimension of rigour, which facilitated a degree of analysis that proved important in establishing credible, reliable results.

This structured approach to evaluation was an important part of demonstrating credibility to fellow researchers in agricultural sciences, many of whom are accustomed to traditional positivist modes of enquiry, and less accustomed to qualitative methodologies based in an interpretivist epistemology.

6. Implications

This research was funded and conducted in the mode of a pilot project. It set out to establish if in fact it was possible to use the internet for interactions centred on cropping systems simulation using a methodology already proven in face-to-face interactions. This project has clearly demonstrated the feasibility of online meetings, and describes the constraints, both technical and social.

Farming in Australia is an isolated and remote business, and as such has traditionally suffered from, as the cliché goes, 'the tyranny of distance'. The internet has the potential to reduce the effect of distance to the extent that it gives isolated farmers access to services, which otherwise may not be accessible due to cost of delivery.

As mentioned in the introduction, such advances are being made in the medical field in providing high-quality specialist medical services to isolated places at an affordable cost. Telecommunications infrastructure, mainly as it affects bandwidth, seems to be the primary barrier to major use of this technology in agriculture.

7. Recommendations

In our view, results from this project suggest three important opportunities to further this approach.

The approach we have trialed has demonstrated the feasibility of holding computer-aided discussions with geographically-dispersed farmers via the internet. This establishes two opportunities for delivery of FARMSCAPE-based services. One of these is the delivery by consultants accredited as FARMSCAPE facilitators. A second opportunity is for the facilitation of enhanced farmer learning-in-action through new monitoring activities within normal farming practice and through explorations of consequences of contemplated management change using simulation. While this is less advanced than the consulting option, there may be a significant niche for rural adult education so closely coupled with situated farming policy and operations. There exists an opportunity to develop an online method for consultants to provide farmers with customised and timely soil monitoring and simulation via the internet for their farmer clients' decision making.

Not long ago, farmers whose 'willingness to pay' now provides the rationale for investment in accredited service provision were not coy about their view that models were toys for scientists. If any service is to extend much beyond participants in past FARMSCAPE research projects, it will depend on additional farmers having experiences in which they come to see value in seeing and doing certain things differently. Recent research has shown that 'what if's can be efficiently held using internet meeting technology, and farmers who are now experienced in these matters judge them to be no less valuable than in the face-to-face mode. An action research programme has recently begun using this communication medium to see if interested farmers can be effectively coached from a distance in learning- and reflecting-in action within their farming practice on the soil and crop matters pertaining to use of simulation in planning and decision making under climatic risk.

An important opportunity has been identified to further develop the online soil guide. By adding a body of relevant theory and enhancing its interactivity, this could form the basis for an online course in matters relating to managing and understanding the soil as a resource. Results from the current project suggest that this has real potential to aid farmers learning about key soil processes and agronomic practices that provide insights for better crop and soil management.

Farmers are often not well situated to take advantage of relevant adult education opportunities. We believe there exists an opportunity to deliver relevant management trials within farmers normal farming operations coupled with educationally−and practically−meaningful interactions about these without leaving the farm.

Jim Groves (1999:vii) rightly highlights the important potential here by stating that the internet provides:

> '…remote delivery, resulting in time savings to participants and access benefits to otherwise busy or remote people.'
>
> '…improved access possibilities, including for those geographically isolated…'

Groves goes on to state:

> 'The provision of formal education and training opportunities is one of the major potential applications of the internet−possibly only second to electronic commerce.'

> ‘Internet delivery particularly offers opportunities for rural and remote residents, such as primary producers, to access education and training services for themselves and for their families.’

There appears to be a general under-appreciation evident of the potential to conduct highly interactive online meetings, within agriculture. There are plentiful references to web pages, web page content, interactive web pages, and chat facilities; however there is little if any reference to using the internet for *interaction* between people for the purposes of completing time sensitive tasks at reduced cost.

8. Appendix

Online reporting and data collection template

Planning

Plan the nature of the activity, including devising questions to be answered; aims of the research; and negotiating the activity with farmer participants.

- Farmer issue objectives.
- Research objectives.
- Background: previous engagements, what led to this session.
- Operational plan: general planned approach to 'what if'.

Action/data collection

- Log of event.
- Data collection at two levels: i) farmer issue; and ii) research issue.
- Formal *evaluation data* and informal *perceptions* of researchers.
- Potential methods include field notes, audio recording, video recording, structured entry/exit questionnaires, external evaluation, and interviews.

Documentation

Document the experience and actions according to the frame, context, and background as described in the planning stage.

- Relate data to farmer issue objectives, background frame, etc.
- Relate data to research objectives, background frame, etc.

Reflection / Interpretation

- Research team to reflect on and interpret *farmer issue* data.
- For example: i) how effective was the attempt to assist farmers; ii) problems/solutions; and iii) logical next step to assist this group, etc.
- Research team to reflect on and interpret *research issue* data.
- Technique: 'what if', APSIM, our approach, methods, and methodology.
- Develop theory from/relate theory to data collected.
- What new questions does this pose?
- Methodological/philosophical implications (if any).

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