FARMSCAPE online- developing a method for interactive Internet support for farmers situated learning and planning

D.M.G. Hargreaves, Z. Hochman, N. Dalgliesh and P. Poulton

CSIRO/APSRU, Toowoomba, Qld.

Abstract

Farmers in Australia's Northern cropping region are using the Internet to increase timeliness and reduce costs of interactions with researchers on production issues they see as important. Farming in this region is a risky enterprise, due in large part to high climatic variability. This risk is further exacerbated by the increasing popularity of crops with high-input requirements such as dryland cotton. A mix of interactions, tools and techniques known as 'FARMSCAPE online' uses soil and weather monitoring, crop simulation, group discussions and evaluation to jointly explore issues of significance to farmers via the internet. This paper describes a low-cost approach for simulation-aided internet aided management discussions.

Key words

Internet, FARMSCAPE, action research, simulation.

Introduction

Farmers on the Darling Downs, whose greatest production constraint is climatic uncertainty, have found value in Internet based interactions centred on crop simulation. This is based on an approach for engaging farmers, advisers and researchers in simulation-aided interactions developed over seven years of research, called FARMSCAPE: Farmers, Advisers, Researchers, Monitoring, Simulation, Communication And Performance Evaluation (5).

This approach involves farmers undertaking programs of soil and weather monitoring in order to specify the crop simulator APSIM: Agricultural Production Systems simulator (6). The simulator is then run for farmers individual paddocks using these data to explore issues farmers have indicated as important. Traditionally this involves farmers, advisers and researchers discussing the results around a farmer's kitchen table. Such discussions usually include farmers asking 'what-if' questions that are addressed by simulation where experimentation, or learning by trial and error, would be too costly and ineffective.

As demand grew among farmers for kitchen table sessions, our ability to meet this demand gradually declined. As a group, APSRU's (Agricultural Production Systems Research Unit) core business was research, not service provision. In order to address this situation, we started two related research activities. We have initiated a process of commercialisation with four agribusiness companies from northern New South Wales to Central Queensland. At the core of this commercialisation is a training and accreditation program, of which the first two modules have been designed and delivered, with the remaining four modules to be delivered over the next 18 months.

The second strand of our approach involves using the Internet to increase timeliness, and decrease costs of holding simulation-aided sessions via the Internet. This research has involved conducting simulation-aided discussions via the Internet.

In this paper we present a set of methods, which have emerged through a joint Action Research program with farmers. We adopted an Action Research methodology with each cycle informing the next phase of activity. We define Action Research as described by Checkland (2) as a process for developing a methodology through progressive cycles of *learning in action*. This approach conforms to the 'plan, act, observe, reflect' cycle, with particular importance placed on the observation component; expanding this out to include a formal program of evaluation. Our evaluation process includes a range of processes including exit/entry questionnaires, face-to-face and telephone interviews, case studies, direct

observation and video analysis. The work of Coutts *et al* (3) contributed significantly to our approach to evaluation.

Results and Discussion

The primary outcome of this research is the development of a set of methods for engaging farmers in simulation aided management discussions via the Internet. These are described below.

Half-day soil workshop

Our involvement typically begins with APSRU researchers conducting a half-day face-to-face soil workshop for farmers. These workshops include a series of *situated* discussions between farmers and researchers about soil processes and participants' farm soil properties on farms. The workshops include active discussions about: i) landscape history; ii) hands-on soil sampling; iii) a number of soil cores, to a depth of 1.8 meters, from participants farms and; iv) data on soil properties calculated from laboratory analysis.

The aim is to provide farmers with the opportunity to *see* their soil resource in alternative ways. The cores allow participants to see soil properties at depth (eg rooting depth, soil texture, relative moisture, colour), the data provides a graphical representation of these and other properties which cannot be readily observed, but which can be measured. The cores are processed for Plant Available Water Capacity (PAWC), Nitrogen (N) content through the profile, Electrical Conductivity (EC), and Bulk Densities (BD) as described by Dalgliesh and Foale (3).

As much as possible we attempt to engage farmers in a process of *active learning*. Our evaluation shows that most farmers who attend these workshops have *mental-models* of the soil water environment commensurate with that of a model of ‘depth of wet soil’. This model of the soil water environment is supported by the use a *soil push probe* to measure using resistance as an assessment ‘how deep the soil is wet’.

Much of the activity undertaken during the soil workshop encourages a representation of the soil water environment consistent with that of Plant Available Water Capacity (PAWC). Our research suggests that active discussions between farmers and researchers around the soil cores often leads to learning’s which contribute to farmers *mental-models* of the soil shifting from ‘depth of wet soil’ to one of PAWC, or what has become known locally as ‘the bucket’. Seeing the rooting depth of plants, feeling the relative wetness or dryness throughout the profile all contribute to understanding the soil resource in a different way.

Monitoring a season

Evaluation undertaken after the half-day soil workshops reveals a declared intent among participants to increase soil-monitoring activity is generally high. APSRU researchers work intensively with interested farmers during one cropping season, by providing soil and weather monitoring support and access to a hydraulic soil-coring rig, an automatic weather station, and other equipment such as electronic scales.

Monitoring programs are developed jointly with these farmers and are centred on issues of significance nominated by them. Common issues suggested by farmers include evaluating the variables of row-spacing, planting rate, nitrogen application, and planting date as they relate to yield and gross-margins. Paddocks are selected; monitoring strategies are designed and the monitoring begins. Monitoring is conducted from pre-plant, to post-harvest.

Real-time internet meeting- soil data, benchmarking simulation

Data collected by farmers are sent to APSRU researchers in Toowoomba for laboratory analysis before the meeting. These data serve an important dual role: farmers find that the graphic representation aids

their seeing the soil environment in increasingly sophisticated ways; with the data further used to specify simulation for benchmarking activity.

Our observation is that farmers place value on the soil data in its own right. Representing the data graphically partially makes transparent soil properties that are otherwise too complex to appreciate. Farmers often verbally overlay their experience of growing the crop to the data presented. They recount their memory of the physical appearance of the crop, soil and rainfall events to the data, which are presented using specifically designed Excel spreadsheets. These data are presented back to the group via the internet using Microsoft NetMeeting™ (described later). Active discussions about management then take place between farmers, with their actual experience of growing the crop; and researchers, with 'scientific' *mental models* of soil processes- centred on these graphical representations.

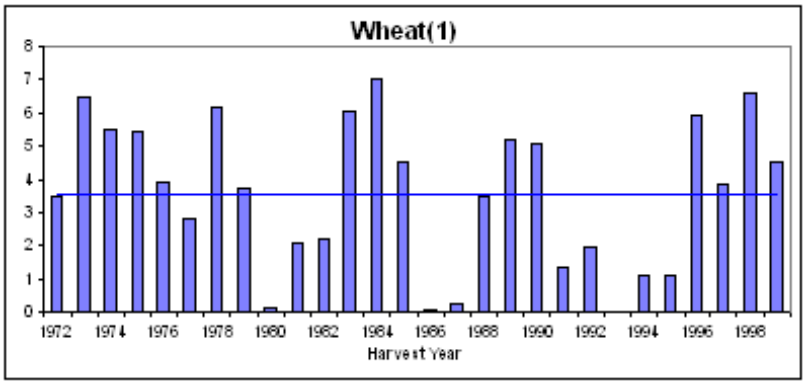

Figure 1

These data are then used with crop simulation to *benchmark* the previous seasons crop. Benchmarking involves specifying the simulator for soil conditions, seeding rate, crop type and variety, among other things- for the farmer's paddocks being investigated. The simulations are then presented, again using NetMeeting™, and farmers have the opportunity to compare their 'actual' yield with APSIM's prediction for the past season.

Our experience shows that farmers value highly the ability to ask the question: "What if I had done…" during the last season. Farmers can do 'virtual experiments' using the crop simulator to try different row spacings, planting rates and dates etc. In our view, the most important learning occurs, for both farmers and researchers through discussions that take place around the simulation outputs. These discussions bring expert farmers with highly *situated* understandings of their production and management system together with researchers who have expert understandings of *non-situated* theory as it relates to agronomic science. Figure 1 provides an example of APSIM output, with predicted yields for the period for the years 1972 to 1999.

A set of methods for simulation-aided interactions via the internet is emerging from our research. This set of methods is described below:

i. Microsoft NetMeeting™ is installed on participant's computers. The software is available for downloading (free of charge) from the Microsoft website (www.microsoft.com/netmeeting). NetMeeting™ allows two way voice and video between two sites, with multiple site application sharing (ie shared screens) chat and whiteboard. We use NetMeeting™ with an Internet Locator Server (ILS) that acts as a directory allowing parties to connect. This essentially requires a server that all parties can access and is often hosted on a commercial web server. Microsoft now offers a companion product to NetMeeting™ that circumvents the need to have a dedicated ILS. This software is called Microsoft Messenger™ and is also available for free download. Messenger™ essentially allows users to keep personal address books of other users, thereby providing increased security and privacy over an ILS.

ii. While APSRU researchers are connected to the Internet via a 128kb/s ISDN line, speed and reliability are tested at the farmer's property. If the line speed and/or reliability are judged to be inadequate, we install a Maestro Woomera™ modem designed with assistance from the National Farmers Federation Farmwide Internet trial. The Woomera™ modem is designed to allow automatic detection and adjustment to optimal line *impedance*. Our direct experience with this has shown that for some poor rural connections that drop out every 10 – 15 minutes, the Woomera™ modem is able to maintain a stable connection for up to two hours (and quite possibly longer). Without elaboration here, this device uses simple Artificial Intelligence to record information about individual phone lines, and then adjust appropriately. At time of publication the approximate cost of the modem is $250.

iii. Monitor resolution is established on the farmer's computer. Typically the resolution is 800x600 pixels. APSRU researchers are mindful of farmers resolution during material preparation. Designing graphics at higher resolutions (ie 1024x768) can result in only part of the graphic being displayed on the participants monitor.

iv. Graphs are designed using a pre-prepared Microsoft Excel™ spreadsheet template that conforms to the resolution of the farmers monitor. Each graph is placed on a separate Excel *sheet* with the background set to white. This minimises 'scrolling' and the need to move frequently between *sheets*, which causes the often-limited bandwidth to be quickly consumed.

v. If APSIM is to be used during the session we select an 'online' version of the interface that removes large background graphics, thereby making the interface faster to download.

vi. A telephone conference call is established via the telephone switchboard at APSRU. We use an Ericcson Consono MD110 switchboard, and with Sound Station™ conference phones. These phones have several microphones located in a star arrangement; and in our experience provide vastly superior audio performance for group sessions with five to ten participants.

APSRU researchers have expressed frustration with the difficulty of perceiving farmer reactions to outputs from the research end during an online session. Due to limited bandwidth we use video to 'bracket' the sessions, at the beginning and end. Evaluation has demonstrated on a number of occasions where farmer participants displayed clear enthusiasm in relation to particular outputs- but the perception of this was lost on the researchers in Toowoomba due to limited video quality. Even with constant video, the resolution is not currently sufficient for clear representations of activities. It is expected that increased bandwidth will address this issue in the near term, particularly through the use of 2-way satellite technology. There are several options available here: some groups have an agribusiness consultant or state department extension officer who could fill this role. With other self-formed farmer groups, we may negotiate for an interested and skilled farmer to perform this role.

Our current research is focused on developing methods for group facilitation via the Internet benchmarked against a standard of interaction that we achieve with face-to-face facilitation. To date we have attempted to facilitate the farmer group remotely via the Internet from Toowoomba. Reflection on recent evaluation suggests that the quality and fluency of the session could be aided by having a briefed facilitator together with the farmer group.

Conclusions

Our research shows that online simulation aided discussions are not only feasible and practical, but results in reduced costs and increased timeliness. Farmers consistently indicate a preference for interacting online, citing timeliness, convenience and improved access as reasons. Our research also indicates that interactions are effectively despite slow Internet connections speeds (<28.8 kb/s). Recent developments such as 2-way satellite technology confirm our expectations that the barrier of inadequate rural infrastructure is rapidly diminishing. The set of methods described above describe a set of methods we use to consistently undertake reliable online interactions with few line dropouts.

Acknowledgments

We would like to make special mention of the organisations that have funded this research: RIRDC and GRDC. We would also like to thank the TopCrop project. Lastly we wish to thank Moonie farmer group participants, for without their participation, none of this work would be possible.

References

1. Checkland, P.B. 1981. Systems Thinking, Systems Practice. John Wiley & Sons, Chichester.

2. Coutts, J. 1998. et al. Evaluation of Participative Approaches to RD&E: a case study of FARMSCAPE. *Proceedings 9th Australian Agronomy Conference*, Wagga, Wagga, NSW.

3. Dalgliesh, N. & Foale, M. 1998. Soil Matters: Monitoring Soil Water and Nitrients in Dryland Farming. CSIRO, Toowoomba.

4. Hochman, Z. et al. In: Learning And Knowing Processes For Change In Agriculture In Industrialised Countries. (Ed. B. Hubert and R. Ison) (*INRA*: Versailles)

5. McCown, R.L. et al 1998. The FARMSCAPE approach to farming systems research. *Proceedings 9th Australian Agronomy Conference*, Wagga Wagga, NSW.

6. McCown, R.L. et al 1994. APSIM: a Novel Software System for Model Development, Model Testing and Simulation in Agricultural Systems Research, Agricultural Systems, Elsevier Publishing, Great Britain.