

# A MANUAL OF TOOLS FOR PARTICIPATORY R&D IN DRYLAND CROPPING AREAS

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A report for the Rural Industries Research  
and Development Corporation

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## FOREWORD

Agricultural research and development (R&D) agencies, private sector consultants and industry organizations in Australia are embracing new paradigms in their efforts to manage change, and to overcome the perceived failings of traditional R&D methods. Some of the new approaches, such as *farming systems research* and *participatory action research* have been adapted from the field of international agricultural development, while others such as benchmarking, are drawn from other industries or from the field of management. One common feature of the new order of approaches in agricultural R&D is *client participation*. Another characteristic is the emphasis on *co-learning* between farmers and researchers and extension agents—and a movement away from reliance only on teaching and technology transfer.

The outcome of this project is a *Manual of Tools for Participatory R&D in Dryland Cropping Areas*. The intended audience is research and extension agents and other facilitators of rural change, who seek ideas for making their experiential learning activities with farmers more participatory. The term ‘tool’ here is used very broadly, to cover a range of activities, equipment or materials that have application in participatory learning processes—from kits for testing soils, to computer software, to interactive workshops, farm trials and other events.

It is intended that this manual will provide a source of ideas, materials and contacts for extension agents and other facilitators of rural change, who strive to develop more participatory and effective learning activities with farmers. The summary review of participation and extension provided in the Introduction to the manual will help users to gain an understanding of the principles of designing participatory processes in their extension work.

This project was funded mainly from RIRDC Core Funds which are provided by the Federal Government.

This Manual is a new addition to RIRDC’s diverse range of over 450 research publications, forms part of our *Human Capital, Communication 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  
Rural Industries Research and Development Corporation

## ACKNOWLEDGEMENTS

Thanks are due to a large number of extension agents, consultants, and other rural professionals across Australia who offered advice on the concept, contents and layout of this manual. Those who submitted descriptions of suitable tools for the project are acknowledged as authors of papers within this 'edited' manual. Many declined to submit papers but supplied materials or publications, which are mentioned in the appendix. Some of the material submitted was not utilised directly in the manual but helped to give a picture of the scope of participatory (and non-participatory) extension activity across Australia. The *Australasian Pacific Extension Network Newsletter* and editorial staff were helpful in advertising the concept of the Manual and in seeking contributions and comment. Brendan Williams of GPS Ag and DNRE staff at Bendigo provided initial support and advice on the concept of the manual. Staff at Longerenong College and David Lawrence in Queensland have been valued colleagues in providing encouragement and useful advice. Robin Jean has been a source of valuable information and ideas on layout and presentation.

## **ABBREVIATIONS**

|                |                                                            |
|----------------|------------------------------------------------------------|
| <b>AKIS</b>    | Agricultural knowledge and information system              |
| <b>AWB</b>     | Australian Wheat Board                                     |
| <b>BMP</b>     | Best management practice                                   |
| <b>CCN</b>     | Cereal cyst nematode                                       |
| <b>CFA</b>     | Country fire authority                                     |
| <b>CRC</b>     | Cooperative research centre                                |
| <b>DNRE</b>    | Department of Natural Resources and Environment (Victoria) |
| <b>DSS</b>     | Decision support system                                    |
| <b>EC</b>      | Electrical conductivity                                    |
| <b>GM</b>      | Gross margins                                              |
| <b>GRDC</b>    | Grains Research and Development Corporation                |
| <b>IPM</b>     | Integrated pest management                                 |
| <b>LIC</b>     | Lower income country                                       |
| <b>LMS</b>     | Land Management Society                                    |
| <b>LNC</b>     | Lime and Nutrient Calculator                               |
| <b>NRM</b>     | Natural resource management                                |
| <b>NLP</b>     | National Landcare Program                                  |
| <b>OHT</b>     | Overhead transparency                                      |
| <b>PAR</b>     | Participatory action research                              |
| <b>PI</b>      | Political instrument                                       |
| <b>PIRD</b>    | Producer initiated research and development (grants)       |
| <b>PAR</b>     | Participatory action research                              |
| <b>PRA</b>     | Participatory rural appraisal                              |
| <b>RBM</b>     | Rural business management                                  |
| <b>RIM</b>     | Ryegrass integrated management                             |
| <b>RIRDC</b>   | Rural Industries Research and Development Corporation      |
| <b>R&amp;D</b> | Research and development                                   |
| <b>TOT</b>     | Transfer of technology                                     |
| <b>SARDI</b>   | South Australian Research and Development Institute        |
| <b>SAS kit</b> | Salinity, acidity, sodicity kit                            |
| <b>SOI</b>     | Southern oscillation index                                 |
| <b>VIDA</b>    | Victorian Institute for Dryland Agriculture                |
| <b>WCFA</b>    | Wimmera Conservation Farming Association                   |
| <b>WFP</b>     | Whole farm planning                                        |
| <b>WUE</b>     | Water use efficiency                                       |

## EXECUTIVE SUMMARY

The project commenced in 1998 with a review of the scattered and relatively recent Australian literature on ‘tools’ in effective use by extension agents and other rural facilitators in gaining participation by farmers in R&D activities. Although participatory tools and farmer learning processes are regarded by many R&D professionals as a ‘cutting edge in current R&D activity’ in the development of farming systems, little information on this topic finds its way into formal scientific publications in Australia. Therefore, much of the work for this project involved contacting agencies and individuals reported to be active in this area, and seeking their ideas and contributions of ‘descriptions of tools’—for the *Manual of Tools* which is the major output of this project.

Rural extension professionals across Australia were invited to contribute descriptions of tools with which they had personal experience in their work with farmer or community groups. The descriptions submitted were edited in a fairly standard four-page format, for presentation in the *Manual of Tools for Participatory R&D in Dryland Cropping Areas*. The authors were asked to supply information on original sources of materials used in their tools, and on references and contact addresses.

The term ‘tool’ is used here very broadly, to cover a wide range of activities, equipment or materials that have application in participatory learning processes—from kits for testing soils, to computer software, to interactive workshops and other events. Two main criteria were adopted in the selection of tools for the manual:

- . evidence of previous successful use in farmer learning activities; and
- . evidence of a clearly participatory process.

Some tools were excluded because they were considered to represent examples of interactive teaching, rather than participatory learning. Advice was received from extension professionals and rural consultants on application of these criteria, and on the concept, design, and format of the manual.

The tools are arranged in the manual under ten categories:

- . crop nutrition and disease;
- . weed management;
- . pasture management;
- . community planning and natural resource management;
- . soil management;
- . farm monitoring;
- . on-farm trials and demonstrations;
- . farm family business, marketing and skills;
- . climate and risk;
- . participatory field visits.

Although the objective of this project was to produce a manual of tools, the research revealed interesting information on the range of tools being used, some trends in participatory R&D and the importance of process versus technical tools themselves.

Tool types encountered in the study included:

- . kits containing equipment for use by farmers in measurement of key farm variables, in a group—and in some cases at home (e.g. soil monitoring kits);
- . mechanical models for use by groups learning about a complex concept (e.g. the SOI);
- . icons for use in explaining a mechanical concept (e.g. sponges for soil water relationships);
- . boards or games for use by small groups in defining group aims (e.g. SEEK skills audit);
- . computer models to allow exploration of alternative management strategies (e.g. FARMSCAPE and RiskyBusiness for risk management);
- . workshops with participatory elements, based on farmers using their farm data;
- . outdoor exercises, based around field activities, such as soil or crop examination;
- . community workshops, based on maps and a process to tackle some common problem;
- . long-term processes, based on farm monitoring and sophisticated services supplied to groups by commercial provider (e.g. MarketCheck);
- . on-farm trials: researcher designed/farmer run, farmer designed/farmer run;
- . interactive group visits with touring groups; and
- . simple, tried activities such as (well planned) farm walks.

Interesting developments encountered in participatory R&D included the accreditation of participatory learning workshops as a component of formal courses at education institutions (e.g. weed identification workshops, whole farm planning). Another trend appears to be towards the commercialisation of provision of certain types of program involving farmer participation (e.g. MarketCheck).

The four-page descriptions of tools are deliberately brief. Several experienced contributors emphasised that the most important aspect of participatory work is not the technical details of the tool, or even participation itself—but the intent of the user and the process in which the tool is used. Each tool needs special adaptation to local circumstances, and innovation by facilitators in its use for particular purposes in facilitating learning.

A brief introduction to theory of participation and participatory processes in extension is therefore provided in sections 1.3–1.9 of the manual. This mentions some of the terminology and philosophies relating to extension, participation and learning, and provides further references to these areas.

Contact names and institutions are given for authors of tools, and further references to tools are provided under each tool where available.

The 33 tools included in this manual represent only a small sample of the large and growing number of tools in use in participatory R&D with farmers and community groups. Many known, suitable tools are omitted because the users were unable to provide written descriptions in the time available to them. Although some costs in producing tool descriptions were covered by this project, the main incentives for submitting contributions was authorship of a paper in this RIRDC publication, and promotion of their work in participatory R&D. It was suggested by various contributors that this manual should be seen as only a start to documenting ideas on extension tools, and could provide a basis for an internet-based resource on participatory tools and processes, which could be developed in an interactive way by an appropriate organisation over the years.

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## INTRODUCTION AND REVIEW

**R. John Petheram**

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### **A manual of tools**

The aim of this project is to produce an easily accessible *manual of tools* to act as a source of ideas, materials and contacts that will improve the ability of extension agents and other rural facilitators to achieve high levels of farmer participation and hence co-learning, in their research and development (R&D) work with farmers.

The idea for this manual came from extension agents who were studying approaches to R&D in agriculture and natural resource management in postgraduate courses by distance learning through The University of Melbourne in 1996–98. These rural professionals identified ‘a lack of information and ideas on suitable tools for use in participatory activities with farmers’, as a main difficulty in their work as agents of rural change. This concept became the basis of a research proposal to RIRDC in 1998, which subsequently provided funding for this project and manual.

The audience for this *Manual of tools for participatory R&D in dryland cropping areas* is therefore extension agents and other rural facilitators, who seek ideas for participatory learning activities for use with farmers and communities. The 33 tools documented provide a small sample of the large and growing list of materials and ideas available from a diverse range of R&D organisations, government and industry institutions, private groups and consultants in Australia.

Extension professionals and agencies across Australia were invited to provide ideas and contributions towards the manual. The concept and was advertised through a professional extension network and also by contacting extension organisations known to be active in this field. Over 80 individuals responded from five States and around 60 submitted materials or descriptions for use in the manual. Colleagues from extension and the consulting industry acted as a reference group and provided advice on the design and composition of the manual—as a practical aid for use by extension agents.

Two main criteria were used in the selection of tools for the manual:

1. evidence of previous successful use of the tool in farmer learning activities; and
2. evidence of a clearly participatory process.

Some tools were excluded because they were considered to represent merely aids to interactive teaching, rather than tools for participatory learning. Others were considered to be unrelated to cropping or too similar to other tools already included in the manual. Many suitable tools in use in Australia are not covered in this small manual, either because the users did not provide a description of the tool or the tool did not come to our notice during the project. Notably, there are no contributions from the extremely active farmer led groups such as Southern Farming Systems (1999) and the Birchip Cropping Group (Pedley 1995).

In reviewing the tools in use in extension, many experienced rural communicators emphasised that the *process* of designing and running group learning activities is much more important than any tools used, in achieving effective learning. Authors of each tool description were therefore asked to emphasise the process aspects in using the tools or activities, rather than the technical aspects of the tools themselves.

It is accepted here that the successful use of tools in participatory learning depends more on the intent and skill of the user, than on the tool itself. To be an effective facilitator of participatory learning activity, it is necessary to understand some basic principles of participation and adult learning. This introductory sections of this manual therefore include some materials intended to provide general theoretical background for facilitators working across a wide range of disciplines and topics.

### **Tools included in the manual**

One dictionary definition of a tool is an ‘instrument which helps in performing work’. Thus, in the context of this manual for modern extension agents, a tool is *any instrument or activity that assists in the work of promoting learning (and co-learning) amongst farmers and scientists*. ‘Participatory tools’ in extension include both physical devices (e.g. equipment, icons, computers, models) and human activities (e.g. workshops, field activities, games), which are useful in gaining high levels of participation by members of a group or community in a learning process. The range of tools encountered in his project can be seen in the tools and summary descriptions listed in Table 1. The table also shows the 10 categories into which tools are arranged in the manual.

#### **What is a tool ? Tools within tools**

In the context of participatory technology development in lower income countries, one of the most powerful tools is a *video camera* with play-back facility. Showing video footage of people on their farms can be a huge draw-card amongst small-scale farmers; people love to see themselves and neighbours on the screen. So, is video a participatory tool—or merely a gimmick to gain farmer attention!

To be effective as a learning tool in extension, video equipment would need to be incorporated into a well designed learning process. Footage of local people and practices can be used initially to gain farmer interest and attendance, then to seek information on practices and problems (*why people do what they do*) and later to explore farmer opinion on the potential for adaptation of ideas from other areas. In this example, the ‘participatory tool’ is the string of activities based around the physical tool (i.e. the video camera).

*Tools are nothing without the learning process.*

Most of the tools included in this manual are related to specific technical areas in dryland cropping areas (e.g. crop nutrition and disease, weeds control, soil management, farm business, climate and risk). Some of the

examples outlined are designed for community-based activities such as management of common natural resources. Tools on group motivation and direction finding are omitted from this manual, because these areas are well covered in other publications (e.g. Chamala and Mortis 1990, Brouwer 1995) and in the guides of major research and development projects such as TopCrop funded by the Grains Research and Development Corporation.

On advice from various reference groups and experienced extension agents, the descriptions of tools in the manual are kept deliberately brief (around 3–4 pages). The intention is to provide only an outline description of tools so that readers could grasp the idea behind the tool but not be given instructions on how to use it. This approach is intended to encourage users to innovate and to adapt the concept behind the tools to suit particular situations rather than follow prescribed procedures.

**Table 1.** Categories and names of tools in the manual and summary descriptions.

| Categories and names of tool                   | Summary description                                                                                                                                                                                                    | Page number |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Crop nutrition and disease</b>              |                                                                                                                                                                                                                        |             |
| Learning & action on N in cereals              | Action learning process based on workshops with step-by-step N budgeting worksheets, on-farm experimentation & collective review                                                                                       | 17          |
| Estimating nutrient loss & acidification rates | A half-day workshop, with visit to local farm & use of Calculator/tools. Conducted by agronomist.                                                                                                                      | 23          |
| Identifying cereal leaf diseases               | A one day workshop, based on Right Rotations program and manual. Uses plant samples collected by facilitator prior to meeting.                                                                                         | 27          |
| Cereal root diseases – identification tool     | A one day workshop, based on the Right Rotations program and identification guide. Run by a specialist in crop disease.                                                                                                | 31          |
| <b>Weed management</b>                         |                                                                                                                                                                                                                        |             |
| Weed identification                            | One day workshop conducted by trained (accredited) instructor, with comprehensive support materials                                                                                                                    | 35          |
| Integrated weed management                     | Workshops conducted by trained (accredited) instructor over 1, 2, 3 or 4 sessions (total 8 hours). Uses comprehensive support material This accredited course supplies pre-requisite reading and exercises/work sheets | 39          |
| RIM workshops – Ryegrass Integrated Management | A user friendly, bio-economic simulation model, used in workshops with farmers testing various rotations and possible solutions for their farm                                                                         | 43          |
| <b>Pasture management</b>                      |                                                                                                                                                                                                                        |             |
| Best-bet winter pasture cleaning               | Workshop (indoor and outside), using various materials and participatory exercises.                                                                                                                                    | 47          |
| Developing best practice among lucerne growers | A process involving farmer participation in focus groups to help define best management practices (BMP) for lucerne in a region and then designing extension material and program.                                     | 51          |

| Categories and names of tool                                        | Summary description                                                                                                                                                                                                                                                                                                                                                    | Page number |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Community planning and NRM</b>                                   |                                                                                                                                                                                                                                                                                                                                                                        |             |
| Participative catchment planning                                    | Six hour workshop, using air-photos and maps. Participants given Planning (mapping) Kit and data to work with in developing a collaborative plan.                                                                                                                                                                                                                      | 55          |
| Capturing community understanding of NRM                            | Combination of individual activity, focus group discussion in a facilitated workshop and field (sampling) activities.                                                                                                                                                                                                                                                  | 61          |
| 500 Farm Plans Later – a group farm planning process                | A series of 7 or 8 workshops, designed with participants to cover important soil, land and business issues in the area. Air-photos used as basis for mapping and physical planning. Participants present their plans to group at last session.                                                                                                                         | 65          |
| <b>Soil management</b>                                              |                                                                                                                                                                                                                                                                                                                                                                        |             |
| Soil Check                                                          | Two workshops (4–8 hours each) one pre-season and one in-season. Both can be done as a one day workshop if soil pits are available in summer.                                                                                                                                                                                                                          | 71          |
| Understanding soil water                                            | Workshop, using various equipment, icons and materials and participatory exercises                                                                                                                                                                                                                                                                                     | 77          |
| Know your ... soils / soil biology / farm hydrology                 | One day workshop on each topic. Participants are offered a choice of modules within topics. Presented by the Land Management Society, using specialised equipment.                                                                                                                                                                                                     | 81          |
| Salinity, acidity, sodicity (SAS) kit                               | Farmers on farm planning course bring samples of own soils to test (using SAS kit) and discuss results in relation to their farm.                                                                                                                                                                                                                                      | 85          |
| <b>Farm monitoring</b>                                              |                                                                                                                                                                                                                                                                                                                                                                        |             |
| Crop monitoring                                                     | Farmer groups monitor their crops, using TopCrop guides, recording systems & materials, led by a TopCrop facilitator.                                                                                                                                                                                                                                                  | 89          |
| The LMS farm monitoring kit (environmental)                         | Group members purchase a kit & attend one-day workshop. Farmer's sites monitored monthly in year 1, quarterly in later years; soil measurements made once a year. Phone workshops & a quarterly Bulletin for follow-up.                                                                                                                                                | 93          |
| Monitoring for IPM: using beneficial insects                        | On-farm monitoring of whole crops. Growers & advisor monitor for pests & beneficial species. Key pests are identified & these & their major natural enemies are monitored as basis for joint management decisions.                                                                                                                                                     | 97          |
| <b>On-farm trials and demonstrations</b>                            |                                                                                                                                                                                                                                                                                                                                                                        |             |
| Adaptation trials on farms                                          | An idea is tested on farms according to a standard format. But farmers are encouraged to adapt the idea to suit their situation. Interest is mainly in farmer opinion of the potential of the idea, rather than in statistical differences.                                                                                                                            | 101         |
| Test as You Grow – a kit and service for broadscale on-farm testing | A kit with materials & manual as a guide for farmers (or groups) in planning on-farm trials. Includes a fast track (fax) system for seeking advice and resourcing tests. Suggestions are faxed back on simplest, practical designs. Tests are registered & groups are able to exchange designs and to link tests – giving opportunity to improve statistical validity. | 105         |

| Categories and names of tool                                  | Summary description                                                                                                                                                                                                                                                                        | Page number |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| On-farm trials – for participatory development                | Involvement of farmers in the design and conduct of trials on their farms, using standard farm machinery.                                                                                                                                                                                  | 109         |
| Lessons from the conflicts of a long-term demonstration/trial | A long-term, paddock-scale trial, instigated by a farmer group. Managed by a scientist & farm manager, working under a farmer <i>management committees</i> . Monitoring by a <i>technician</i>                                                                                             | 113         |
| <b>Farm family business, marketing and skills</b>             |                                                                                                                                                                                                                                                                                            |             |
| BizCheck                                                      | Group workshop, farmer data input, individual business benchmark reports. Feedback workshop to discuss group results and ranges. BizCheck kit and Profit and Loss Statement.                                                                                                               | 117         |
| MarketCheck                                                   | Facilitators provide, over one year period: One day workshop, 3 seminars, (post-sowing, pre-harvest & post-harvest; weekly fax showing case study crop is being hedged.; Daily email on market prices & information.                                                                       | 119         |
| Growing the family farm business                              | A one-day workshop, or series of workshops, utilising a set of six papers (each of 4 pages) entitled 'Putting the Family Back into the Family Farm'                                                                                                                                        | 123         |
| Skills audits – using SEEK                                    | The SEEK – or Skills, Evaluation, Education Kit, is used in 2–3 hour workshops. May be run by a facilitator, or by the group following the instruction booklet.                                                                                                                            | 129         |
| <b>Climate and risk</b>                                       |                                                                                                                                                                                                                                                                                            |             |
| Introducing probabilities – the chocolate wheel & pie charts  | A chocolate wheel is used as one of several alternatives for explaining the concept of (rainfall) probability. Other tools are pie charts & box plots.                                                                                                                                     | 133         |
| Risky Business                                                | Workshop revolving around the use of a bio-economic simulation model. Delivery of Risky Business is restricted to trained license holders.                                                                                                                                                 | 137         |
| FARMSCAPE – for improved management of production risk        | Employs a number of integrated tools & resources, in work with farmers & advisers, individually, in group workshops or on internet. Physical tools for monitoring soil & weather, computers for simulations, historical weather records & data-bases. Procedural rules govern the process. | 141         |
| Introduction to climate terms (for RAINMAN)                   | Workshops held prior to introducing groups to RAINMAN software, using various 'tools' as aids to participation and learning.                                                                                                                                                               | 145         |
| <b>Participatory field visits</b>                             |                                                                                                                                                                                                                                                                                            |             |
| Farmer-led tours – for active, effective group interaction    | Visiting groups are linked with local farmer group. Individuals host small groups to their farms, and visitors report back to main group.                                                                                                                                                  | 149         |
| The paddock walk                                              | Group interaction and development in carefully selected farm paddocks.                                                                                                                                                                                                                     | 151         |

## Tools and participatory R&D

*Farmer participation* has become a *buzz-word* in the policy documents of most agricultural research and development agencies and programs. Indeed, most agricultural R&D workers are involved in participatory activities at various levels with their clients. Yet not all such professionals have training in sociology, education or other disciplines that would help to provide a theoretical basis for work in this field. Participatory R&D has its own language, as well as a set of theoretical concepts, that underpin the activities undertaken. The review of literature in the following sections is intended to provide brief philosophical background on *participation* in relation to agricultural research and extension (or development).

It is frequently said that *tools can be used well, or abused*—depending on the intent and skill of the user—and also that the learning *process is much more important than the tools used*. A sound understanding of the concepts and the terminology of participatory approaches should help facilitators to be more confident and more creative in developing and adapting materials and tools to suit the needs of particular groups and situations.

The general context in which participatory tools are used in agriculture is that of research and development (R&D) for farming systems. Although there are many approaches to farming systems R&D around the world, the overall aim in such R&D is improvement of the farming system. Improvement usually means greater benefits for the farmer, but may sometimes be stated in terms of more sustainable land use or other change. Most approaches to farming systems R&D nowadays recognise that high levels of farmer participation in the R&D process is a fundamental necessity if improvements are to be made. The names (and number) of approaches and methods within rural R&D reflect this trend (e.g. farmer participatory research, participatory action research, participatory learning and action [Okali et al 1994, Petheram and Clark 1998]).

The following review starts with a summary of three broad philosophies that are commonly adopted in agricultural extension. The field of extension is changing rapidly and one feature of the changes is the evolution of models of R&D in which research and extension are not separated, but are seen as part of the same process. Another feature of the changes in extension (and R&D models in general) is attempts to incorporate higher levels of participation by farmers in the process of inquiry and learning needed for improvement of farming systems.

Because the word ‘participation’ is so often used very loosely, there is an obvious need to clarify its meaning and to discuss the levels of participation that are commonly found in R&D projects. It is necessary to consider the terms ‘ownership’ and ‘empowerment’ in relation to participation by people in agricultural and other rural development projects. Concepts such as experiential learning, co-learning and action research and learning are also fundamental to an understanding of participation and the design of participatory processes in extension practice.

### **Some philosophies in agricultural extension**

Until the mid-1980s, the conduct of agricultural extension in Australia was based mainly on theories of adoption of innovations and their diffusion amongst farmers (e.g. Rogers 1983, van den Ban and Hawkins 1988). These concepts—commonly known as ToT (transfer of technology)—are usually combined with theory on marketing, communication, group dynamics and adult learning, and have provided the theoretical underpinning for most extension programs. They are still prevalent in much extension practice today.

However, the notion of ToT from scientists to farmers through extension agencies has been questioned by many theorists because of its link with ‘top-down’ conceptions of the way change occurs (Chambers 1994). The suggestion that extension involves merely the removal of barriers to adoption to ensure that the recommendations of scientists are transferred is now strongly refuted. Such models are unlikely to be useful—especially where complex and long-term issues, such as sustainable management of land (Dunn et al. 1996), are concerned. Extension science is nowadays more concerned with the process of facilitation of change (and equipping people to cope with change in a sustainable way), than with the transfer of technology.

Various ‘process-oriented’ approaches to research and development exist and these are broadly termed here ‘agricultural knowledge information systems’ (or AKIS) perspectives. Proponents of these perspectives (e.g. Roling 1985) consider that farmers operate in complex social and physical systems involving many actors, which need clarifying and understanding, if change in behaviour is to be achieved. These approaches accept that many different actors are involved in seeking change and that farmers must gain access to both knowledge and ‘power’ if learning and hence change is to occur.

Vanclay and Lawrence (1995) mention a third theoretical perspective to extension—in which extension is considered to be a political instrument (PI). Here extension is seen as a legitimate, persuasive and coercive tool of government, which needs to be carefully coordinated with other instruments, policies and strategies to achieve the political aims of the state (e.g. higher production, more sustainable farming). State (and even voluntary) extension agencies inevitably have political agendas and therefore tend towards coercion in their work, even if they adopt seemingly process-oriented approaches. Vanclay and Lawrence (1995) claim that proponents of the PI approach tend to exaggerate the effectiveness of traditional extension in changing behaviour, and to deny the part that farmer-generated knowledge plays in the process of change in farming. The ToT model may work in the simplest of situations (e.g. transfer of a new variety) but is inadequate to bring about the relationships and dialogue required to achieve change in more complex situations, such as development of more sustainable farming.

AKIS approaches typically involve facilitating discussion and inquiry by farmers and other stakeholders, under conditions in which the outcomes are not preconceived. This is based on the notion that farmers have (or can obtain) knowledge to contribute, which can help in devising workable solutions.

An important principle of AKIS philosophy is that success in changing behaviour relative to management of complex problems is more likely to occur if the farmers (or other participants) have *ownership* of the problem and the possible solutions. So, for success, an R&D process must allow farmers to be involved in defining their problems and hence in *owning* these. The farmers must (in the process) first learn about the existence, nature and gravity of their problem(s), but also need to feel some responsibility for finding solutions. The process should allow farmers to use their own experience and knowledge, but also encourage them to access expertise and hence knowledge from other sources.

It is clear that a successful approach to bringing about change in behaviour (i.e. farming practices) would involve a combination of an AKIS approach with a PI perspective, and perhaps ToT. Logically, extension programs would promote active participation of farmers in the R&D process to ensure understanding and ownership of problems, and combine this with extension policies and tools that would maximise the accessibility of information and ideas to farmers in seeking and generating workable solutions.

### **Some theory behind participation**

Although *participation* by clients is a key word in proposals for funding of rural and urban R&D programs worldwide, the word is often used so loosely as to be almost meaningless. Chambers (1994) observed that *participation* is widely advocated as a philosophy and mode in development, but the gap remains wide between fashionable rhetoric and field reality.

It is clear that participation does not necessarily lead to an agenda that solves important problems or which improves the welfare of participants; the level and type (or quality) of participation in programs varies widely. We can learn a lot about the theory and difficulties of achieving high levels of (citizen) participation from fields of social science (e.g. urban or rural planning, health and welfare) where the concept of participation has a much longer history than in agriculture.

In 1969, Arnstein claimed that participation by citizens in the development of their communities and welfare is, in theory, the cornerstone of democracy—a revered idea that is applauded by almost everyone. She proposed, further, that participation is a categorical term for *citizen power*, and that it is such redistribution of power that enables citizens to be included in the process of determining their future. In short, participation is the means by which citizens (e.g. farmers) can induce significant reform or change which enables them to improve their lot in society.

However, many authors stress the critical difference between participation as an empty ritual, and participation in which people are granted the real power needed to affect the outcome of the change process (e.g. Burke 1968). Often in development, participation does not allow distribution of power but *is an empty and frustrating process for the powerless* (Arnstein 1969). Such empty participation is often used by power-holders to claim that all sides have been considered—while in fact only some of those groups are involved or can benefit.

The degree of participation can vary from mere tokenism and even manipulation of participants, to high levels of participation, in which citizens have real power and ownership of the change process. Arnstein

(1969) discussed various types and levels of participation by citizens in development projects. She proposed a typology of eight levels of participation and *non-participation* (Figure 1) in an effort to clarify the confusion surrounding the use of the term.

Each rung in Arnstein's ladder represents a different extent of citizen's power in determining the end product. On the bottom two rungs, participation is somewhat contrived, in that the real objective of allowing some involvement is to 'educate' or 'cure' the so-called participants. Rungs 3 and 4 allow the participants to hear and have some voice but really only in a token way. At this level the participants have not been given power to ensure that their views will be heeded by the powerful and hence there is no change in the status-quo. Rung 5 is simply a higher level of tokenism, because the participants may advise but cannot decide. On rung 6 citizens enter a partnership that enables them negotiate and engage in trade-offs with traditional power-holders. On the top two rungs, participants gain the majority of decision making, or managerial power.

Various reasons have been quoted for the use of high levels of participation in community development (Burke 1968), rural development (Chambers 1994) and in agricultural R&D (Okali et al. 1994):

- outcomes become closely matched to the needs of those involved;
- it is easier to change behaviour of people when they are members of a group than when they are approached individually;
- participants' knowledge and experience can be incorporated into the quest for solutions;
- people involved in problem definition are more likely to 'own' the solutions and be motivated to implement action to resolve problems; and
- change imposed on individuals or groups is more likely to be resisted than change that they have participated in designing.

In 1969 Arnstein estimated that the level of citizen participation in over 1000 community action programs in the USA was no higher than at the lowest level of the ladder in Figure 1. Agencies claiming participation were not handing over power to the participants. In such situations few, if any of the advantages of participation would result from the development process, and hence meaningful change was unlikely to occur. *Is it possible that in agricultural R&D, claims of farmer participation in programs have sometimes enabled agencies to obtain funding that allows them to hold onto the real power, and hence control the agenda, without enabling farmers to significantly direct or own the change process?*

Pretty (1995) proposed a typology of participation for development projects similar to that in Figure 1, and warned that token or manipulative levels of participation can actually threaten the goals of sustainable development. In 1997 he outlined six principles for sustainable development that are common to methodologies operating at higher levels of participation (i.e.

| Type of participation |   |                                |
|-----------------------|---|--------------------------------|
| Citizen control       | 8 | Degrees<br>of<br>citizen power |
| Delegated power       | 7 |                                |
| Partnership           | 6 |                                |
| Placation             | 5 | Degrees<br>of<br>tokenism      |
| Consultation          | 4 |                                |
| Informing             | 3 |                                |
| Therapy               | 2 | Non-<br>participation          |
| Manipulation          | 1 |                                |

**Figure 1.** Ladder of citizen participation (from Arnstein 1969).

those focused on interactive participation and the development of ownership and hence ‘social capital’ among the participants, Figure 2).

A list such as that in Figure 2 could be used as a guide for extension agents in assessing the extent to which their projects and processes meet modern principles for development of social capital in participatory R&D with farmers (Pretty 1997).

**Figure 2.** Pretty’s (1997) principles for methodologies aimed at development of social capital.

1. *Methodology for collective learning.* There are defined and organised methodologies for cumulative learning by all actors; the processes are structured, but rarely as a blueprint; methodologies are context-specific and so there are many variants; the methods encourage interaction—more than just consultation.
2. *User-friendly and quick.* The inquiry and learning processes are user-friendly, as the visual and dialogue methods are simple and widely applicable; processes are group-based and interactive, with people from different disciplines, sectors and mixes of professionals and non-professionals; the processes create enthusiasm and participants have fun.
3. *Diversity represented.* Diversity and inclusion so as to give multiple perspectives are emphasised throughout, with complexity not characterised simply in the form of averages; different individuals and groups evaluate situations differently, and this leads to different actions.
4. *External actors play a key role.* External actors facilitate learning and are concerned with transformations that people in the situation regard as improvements; new attitudes and values amongst professionals are crucial, with listening and facilitating more important than teaching and telling; professionals also contribute technical support.
5. *Self-assessments leading to visions for the future.* External actors help people in their situation carry out their own study and so achieve something; the skills and knowledge of different stakeholders are put at the centre of the process.
6. *Enhanced capacity for action.* The learning process should be the basis for lasting change and the development of individual and organisation capacity; the analysis and debate about change leads to an increased readiness to contemplate action; the motivation to act increases as people find they can do what they never realised they could; action plans identify responsibilities for action and potential sources of funding.

### **Action research, participatory action research and experiential learning**

Action research begins with an imperfectly understood problem, perceived by a group of people who desire to take action to change (improve) the situation. It involves a spiral of steps, each of which comprises the four phases of: planning, action, observation and reflection on the results of action (Reason 1995). Central to action research is a *participatory group*, which identifies the situation of mutual concern and agrees to work together to seek ways of improvement.

Participatory action research (PAR) has been seen as a logical progression from the concept of farming systems research (Petheram and Clark 1998) that emphasises empowerment of the participants and also catalysing local

learning, analysis and action (Chambers 1994, Scoones and Thompson 1994). The PAR concept has gained much attention in LICs. Although PAR is the model aspired to in some new Australian R&D projects, the principles are not often followed (Guerin and Guerin 1994).

Many of the approaches to R&D that are being increasingly adopted in agriculture have similarities with action research, which in itself relies on concepts of adult learning and learning cycles. Kolb (1984) defined experiential learning as ‘the process whereby knowledge is created through the transformation of experience’. In experiential learning there is emphasis on the process of adaptation rather than on content or outcomes, and knowledge is seen as a transformational process; it is continually created and recreated. Kolb (1984) proposed that experiential learning occurs through cycles of experience, reflection, conceptualisation and active experimentation (Figure 3). He claimed that, for learning to occur, all four stages of the cycle must occur; experience is not enough to ensure learning. There must be reflection, conceptualisation and something must be acted upon.

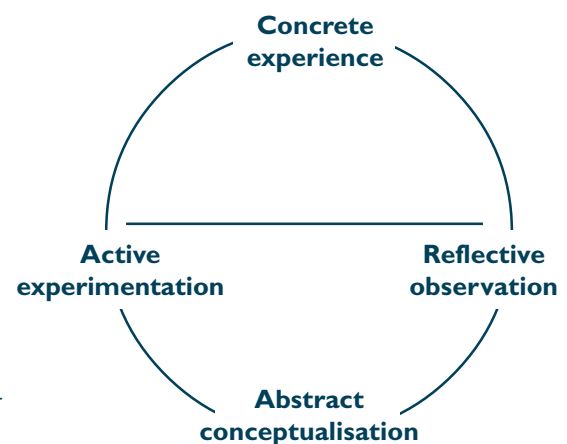
### Action learning and organisational learning

Action learning was described by Revans (1985) as a philosophical framework for combining people’s existing knowledge with their emergent understandings (though questioning) of complex issues. The term is used in the team context, in which members learn with and from each other, in their attempts to solve a problem and then to reflect on and share what was learned (Fulmer et al. 1998). The concepts of action learning are reflected in the term ‘co-learning’, used by Foale et al. (1996) which implies acknowledgement by researchers and farmers of the need in agricultural R&D for a process in which they learn from and with each other.

Whereas traditionally in agriculture, research and extension functions and agencies have been separated, these are increasingly being merged in development programs, in LICs and in Australia. In Australia now there is a tendency for funding agencies to promote R&D programs that combine not only research and extension, but concepts of farmer participation and adult learning. This means that, increasingly, R&D scientists find themselves in working teams, and that concepts of organisational learning are important to their progress.

The concepts of a ‘learning organisation’ (and organisation learning) were popularised by Senge (1990). Dixon (1991) suggested that learning and knowledge have become the critical (organisational) currency—as knowledge constantly needs to be reviewed and updated. She argued that, to survive in these times of rapid change, organisations must continually develop their learning capabilities.

*Organisational learning is the intentional use of learning processes at the individual, group or system level to continuously transform the organisation in a direction that is increasingly satisfying to its stakeholders (Dixon 1994).*



**Figure 3.** A learning cycle; simplified process of experiential learning (Kolb 1984).

Numerous definitions of organisational learning exist, but four common themes are:

1. The expectation that increased knowledge will improve action.
2. An acknowledgment of the pivotal relationship between the organisation and the environment.
3. The idea of solidarity, as in collective or shared thinking.
4. A proactive stance in terms of the organisation changing itself.

In rural R&D in Australia, where institutions, industries and companies are constantly adopting new and untried approaches to their work, and where there is such rapid change, many of the concepts of organisational learning will apply. The emphasis on working in teams and with groups and communities mean that understanding of concepts of organisational learning will be essential. The choice of tools to use in this work will be a function of the underlying philosophies that teams adopt, and of the learning processes selected by teams to suit their various needs.

### **Some notable trends in participatory R&D**

Since 1997 when this manual was proposed, considerable activity has occurred in the development and documentation of tools for participatory work with farmers and farmer groups. Much of that effort, however, has been relatively piecemeal; seldom have tools been collected and presented in easily accessible publications. The compendia of tools that have been published (e.g. Chamala & Mortis 1990, Brouwer 1995) focus mainly on tools and activities for group formation, group motivation and problem solving, which are not covered in this manual.

A feature of many existing descriptions of tools on more practical topics in dryland cropping is that they comprise quite detailed guides for use by facilitators in presenting workshops on particular topics: the tool is very clearly prescribed, and often all the supporting materials are provided. These 'modules' have been useful in gaining conformity in activities of staff of large R&D programs across Australia. Some extension staff commented that such detailed modules risk inhibiting innovation by extension agents in developing learning processes to suit the particular needs and circumstances of clients.

A notable trend in recent years has been the involvement of R&D groups in the development of participatory learning activities (or tools) as part of accredited training programs for farmers on various topics. This appears to be part of a national move towards developing formal qualifications that will allow farmers to receive recognition of prior learning as well as undertake new training in areas important to their farming operation. An example of such accredited training modules which make use of participatory learning principles is shown in the tools on weed identification and weed management in this manual.

In many R&D groups the development of tools for participatory co-learning has become a collaborative activity by specialists in both research and extension. The division between research and extension activities has become less marked than in the past. This trend seems to have been stimulated by the R&D funding organisations allocating significant portions of 'research'

funds towards the task of developing means of ensuring farmer understanding and uptake of results of research. There has been a marked increase in the involvement of private specialists in the development of participatory tools and in the delivery of the learning program in which such tools are used. In many cases, such programs are funded by R&D corporations and the consultants are contracted to provide the services to farming communities over a long-term period.

Another important tendency noted from discussions with extension professionals on the topic of providing tools for this manual was the importance given to ‘evaluation’ as part of the participatory process. Although the evaluation method is usually omitted (for brevity) from the tool descriptions in this manual, there was widespread recognition of the need for evaluation of learning tools as part of the extension process.

### **Observations on the response from extension to tools for participatory R&D**

The response from extension agents asked to provide information and tools for this *manual of participatory tools* was very varied. Although most people contacted were encouraging of the concept of the proposed manual, some showed very little interest, and a few expressed the view that learning tools should not be prescribed and should be developed in relation to a particular learning situation. The interesting range of views expressed by respondents to this project is reflected in Figure 4, which is intended to place the various reactions and contribution on a scale of empathy with current theories of participation and learning.

**Figure 4.** Scale of responses to the concept of a ‘manual of participatory tools’ by Australian R&D professionals.

1. Submitted flexible set of tools for use within a clear context of co-learning, designed to ensure ownership of the process and knowledge by the participants, and hence a gain in social capital
2. Submitted a tool for use in a highly participatory process—which ensured participants would learn from the process (but not necessarily enhance future learning capacity or social capital)
3. Submitted a tool with an example of its use in gaining high levels of participation and in solving problems faced by the participants
4. Submitted tool with little mention of process or adult learning terminology—yet from a group well known for conducting effective participatory learning activities
5. Submitted a tool for use in a predominantly ‘participatory teaching’ context, where little ownership of the process by participants is likely (interactive aids to teaching)
6. Offered to submit tool but unable to provide the description by the due date
7. Professed little or no interest in the concept of tools for participatory R&D

The range of responses in Figure 4 indicated wide differences in both interest in participatory tools, and in knowledge of concepts and terminology of participation or adult learning. It became evident that some practitioners who used quite participatory approaches had had little

exposure to theory relevant to this area of extension practice. Some people expressed the view that high levels of participation are good for all extension, yet found it difficult to define high levels.

N. Cristodoulou and D. Lawrence (pers. comm.) expressed the view that high levels of participation by farmers in extension projects are not always needed—but that the decision as to the appropriate level of participation should be made with the farmer clients. In some extension situations, where the knowledge needed to achieve change resides clearly with experts, farmers may prefer to take part in a fairly traditional ToT (or farmer training) model. As the aims of a R&D project become more complex and the knowledge needed less certain, the requirement for full commitment by farmers to a co-learning process become more important and hence high levels of participation are vital. At the level of the organisation (a farmer or extension institution), it is becoming increasingly apparent that awareness of theoretical principles by team members and their full commitment to a learning process is very important. It seems likely that future extension agencies will be involved in co-working with farmer organisations and groups to determine appropriate co-learning processes and levels of participation.

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## LEARNING AND ACTION ON NITROGEN IN CEREALS

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### **Rationale and process**

*Nitrogen in '95–99* was developed to help advance farmer awareness of nitrogen budgeting methods and assist people to learn how to apply these principles on their own farms. The action learning approach was developed due to concerns about the limited impact of traditional 'transfer of technology' activities. Workshops helped small groups of farmers interpret soil tests from their own paddocks and to develop recommendations for their conditions. The process has been used with existing groups and to help establish groups with an interest in crop nutrition. Participating farmers believed the workshops helped them understand nitrogen (N) and make better N-management decisions. Evaluation studies confirmed that participants put their new learning into practice.

The process is centred around a pre-planting workshop (Figure 1) which can be used in a strongly directed way to tell and even teach people how to calculate nitrogen budgets. However, sharing prior experiences, tracking and discussing progress, collectively interpreting the outcomes and reviewing the value of the process provide a more participatory learning approach that has helped develop on-farm research issues of interest to both growers and scientists. This has been most evident where the process has been used over several seasons. The transition from the 'functional' participation of teaching, towards the 'interactive' participation of co-

### **Objectives**

To develop understanding of basic nitrogen concepts by facilitating application and review of nitrogen budgeting to a commercial crop.

### **Specific learning outcomes**

- Understanding of soil nitrogen processes
- Skills to develop real time strategies for a commercial crop
- Understanding of the basis of nitrogen recommendations from agronomists
- Framework for discussing experiences with nitrogen management
- Development of processes for interpreting their own nitrogen 'responses' and making future nitrogen decisions

### **Tool type**

- An action learning process based on small workshops with step-by-step nitrogen budgeting worksheets, individual on-farm experimentation and collective review

### **Materials**

- Worksheets customised for local conditions (see attached examples)
- Deep soil sampling equipment or farmers own soil nitrate tests to depth
- Soil tests for other key nutrients
- Assessments of available soil moisture
- Recent paddock records of yields, protein and nutrition

No kit is available, as such. A report describing the development and use of the process in Queensland, together with example worksheets, workshop agenda and evaluation material is available from:

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learning (see Pretty 1995) is a key step towards participatory on-farm research.

*Nitrogen in '95–99* presents a simplification of reality, which is needed if any model is to be of any use as a framework for thinking about reality. The simplicity and transparency of the process (Figure 1) helped establish useful dialogue between farmers and scientists, and highlighted the potential contribution of adult learning and action research approaches to agricultural research, development and extension.

## LESSONS LEARNT

For increased grower participation and learning:

- ✓ Taking soil samples with growers as part of the process allows them to get their hands dirty, assess soil moisture and depth of plant roots. It also allows facilitators to better understand farmers' expectations.
- ✓ Documenting participants' paddock histories and the results as they unfold helps people understand and learn from each others' situations.
- ✓ Generating a nitrogen cycle as a group and having samples of stubble, humus and nodulated legumes helps people conceptualise the nitrogen processes by making it more tangible.
- ✓ Strongly encouraging growers to maintain yield and protein records of the 'workshop paddocks' increases future potential for analysis, discussion and co-learning.
- ✓ Explicit reviews of both the crop outcome and the value of the process for making decisions, promote higher order learning. A good decision prior to planting does not guarantee a good crop if the season conditions are 'unlucky' ... *was this years result good management or good luck?*

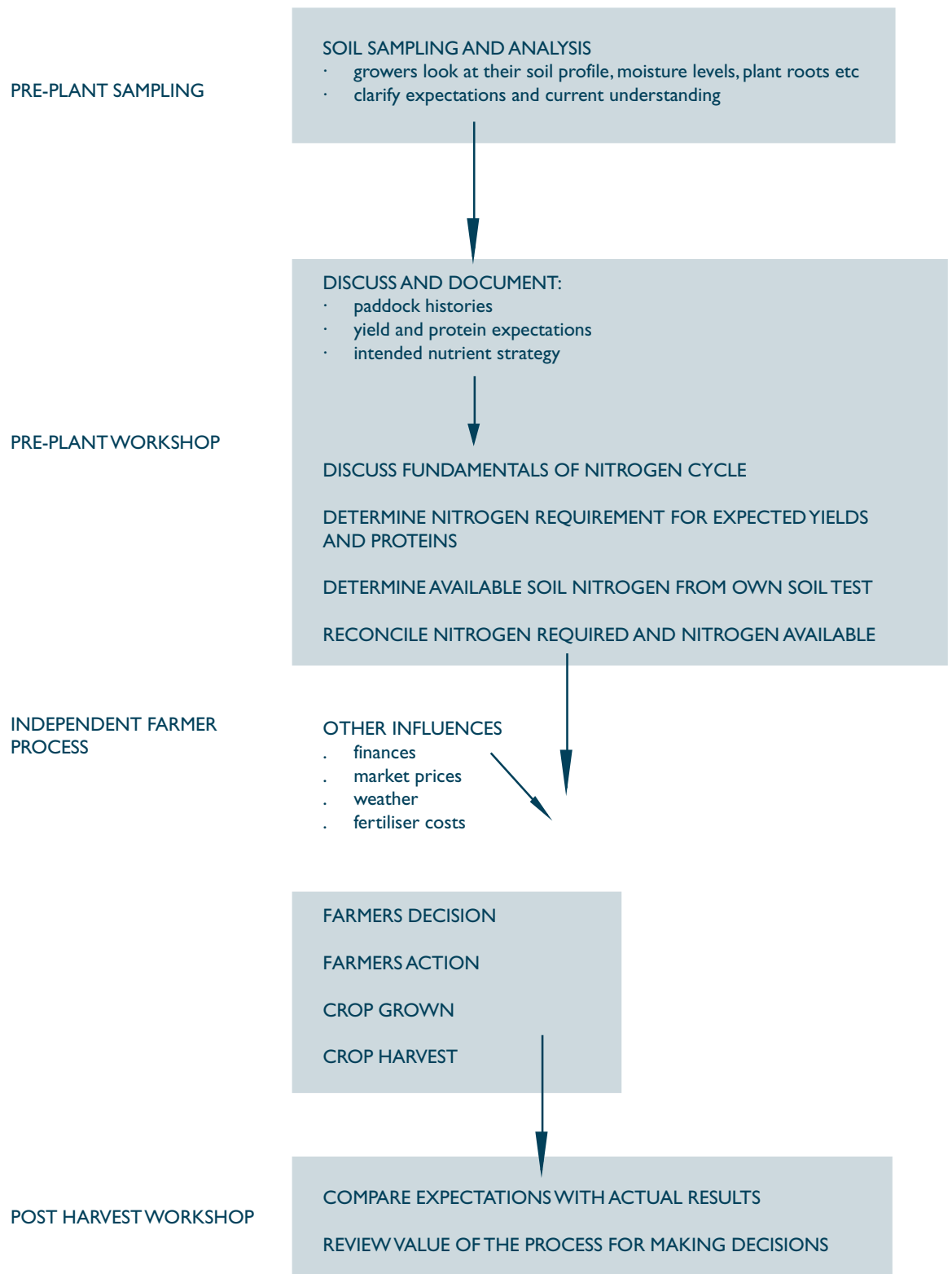
For increased scientist participation and use of learning-based concepts:

- ✓ Glossy booklets that have been developed to a high level of detail, risk becoming a 'take it or leave it option' for potential users. Their greater detail makes them:
  - . more complex and hard to understand;
  - . better suited to a single site and less suited to other sites;
  - . less transparent;
  - . often more daunting.
- ✓ Generic materials with transparent processes seem to encourage people to adapt them for their own situations: an *I can make that better* situation if you like.
- ✓ Principles of adult learning also apply to scientists. The power of participatory approaches appears to be something people have to experience for themselves to fully appreciate.

For evaluation:

- ✓ Documenting paddock histories and growers' intended nutrient strategies at the start of the process, together with their workshop recommendations and actual practices, allows the impact of the project on decision making and practices to be clearly assessed.

**Figure 1.** Nitrogen in '95–99: the process.



## **Typical pre-planting workshop program, lasting 3–4 hours, run with at least two facilitators**

### Introduction

1. Welcome and overview of meeting and approach used.

### Document history of the paddock sampled (sharing experiences)

2. Paddock history for last three years: crops grown, yield and proteins. This session is used as an ice-breaker, but also establishes each person's context for group discussion. Documenting the details on a whiteboard provides a good reference for discussion throughout the workshops.
3. Plans for the coming season. Documenting participants' intentions on the whiteboard establishes a baseline for tracking the impact of the process on their decision making and practices. Open reference to these initial intentions and tracking changes with the group seems to encourage an atmosphere of sharing and learning, which helps participants to see their own progress.

### Understanding nitrogen in cropping soil (facilitated discussion)

4. Key concepts that must be understood to purposefully use nitrogen budgets should be discussed. For example, organic matter as a source of nitrogen, soil fertility decline with cropping, forms of nitrogen in the soil, their availability, relationships between grain protein and yield, the nitrogen fixation process, and the limitations of soil testing.
5. Early workshop series were highly structured, with overhead transparencies and a 'question-and-answer' format. With time, the sessions have become more interactive, with the group's current knowledge used to construct a nitrogen cycle, samples of organic matter, humus and dissection of legume nodules used to make the concepts more tangible.

### Distribute soil tests and interpret results

6. Soil test results for phosphorus, zinc and electrical conductivity are typically distributed and established critical values described. Participants are encouraged to assess their own test levels against the critical levels to decide their requirements for these nutrients.
7. Break.

### Participants work through the nitrogen worksheets for their own crop

8. This more interactive session is usually after a break to separate it from the more prescriptive 'background' sessions described above. To lighten the atmosphere, children's calculators with very large iridescent buttons are used. Jokes about them are common.
9. Participants are led through the worksheets page by page as a group. An example of each step is done on an overhead transparency and the key assumptions for that step explained and discussed. Each person then completes the worksheet based on their own expectations and

soil test results. The results of each worksheet are recorded on whiteboards to allow everyone to see how it unfolds and provide a focus for discussion. For example, some crops will need more added nitrogen which the group may then be able to track back to previous crops or the person's higher expectations for the season.

#### Estimating soil nitrogen without soil tests, using yield and protein records

10. Worksheets using past crop yields and grain protein may be used to estimate the soil's ability to supply nitrogen. This provides experience with a robust alternative to soil testing.

#### Discussion of results and long-term nitrogen strategies

11. A general facilitated discussion is then suggested to reinforce the concepts that people have applied. Comparisons of participants' nitrogen recommendations typically lead to discussion of the impact of water supply on nitrogen requirements, past crops and their performance, perceptions of climatic risk and differing yield expectations. Peter Hayman's 'chocolate wheel' may help address climate risk concepts (see pp. 133).
12. Participants should be reassured that nobody can provide better nitrogen recommendations than they have developed for themselves, unless they undertake more research on their farms to improve some of the generic estimates. Encouragement to apply these recommendations, at least on part of their paddock if they are uncomfortable with it, and to keep good records of any fertiliser used, grain yield and protein to help interpret the results after harvest.

#### **Example worksheet calculations**

Each worksheet typically contains a summary sentence that encapsulates the key concepts of the calculation, some background notes and spaces for participants to enter their own expectations and paddock details

##### **Worksheet 1.** Expected yield given the seasonal conditions.

Expected yield = \_\_\_\_\_ (t/ha)

##### **Worksheet 2.** Expected nitrogen removal in the grain harvested.

Wheat = Yield (t/ha) x Grain protein (%) x 1.75  
 = \_\_\_\_\_ t/ha x \_\_\_\_\_ % x 1.75  
 = \_\_\_\_\_ kgN/ha

##### **Worksheet 3.** Nitrogen needed to grow the crop.

Nitrogen needed to grow the crop = 2 x Nitrogen removed in grain  
 = 2 x \_\_\_\_\_ kgN/ha  
 = \_\_\_\_\_ kgN/ha

**Worksheet 4. Nitrogen available in the soil (from soil tests).**

$$\begin{aligned}\text{Available nitrogen}_{(0-10 \text{ cm})} &= \text{ppm of (N)} \times \text{Soil bulk density} \\ &= \underline{\hspace{2cm}} \text{ ppm} \times 1.1 \\ &= \underline{\hspace{2cm}} \text{ kgN/ha}\end{aligned}$$

$$\begin{aligned}\text{Available nitrogen}_{(10-60 \text{ cm})} &= \text{ppm of (N)} \times \text{Soil bulk density} \\ &= \underline{\hspace{2cm}} \text{ ppm} \times 1.3 \times 5 \\ &= \underline{\hspace{2cm}} \text{ kgN/ha}\end{aligned}$$

$$\begin{aligned}\text{Available nitrogen}_{(60-90 \text{ cm})} &= \text{ppm of (N)} \times \text{Soil bulk density} \\ &= \underline{\hspace{2cm}} \text{ ppm} \times 1.4 \times 3 \\ &= \underline{\hspace{2cm}} \text{ kgN/ha}\end{aligned}$$

$$\begin{aligned}\text{N available in soil profile} &= \text{available N}_{(0-10 \text{ cm})} + \text{available N}_{(10-60 \text{ cm})} + \text{available N}_{(60-90 \text{ cm})} \\ &= \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} \\ &= \underline{\hspace{2cm}} \text{ kgN/ha}\end{aligned}$$

**Worksheet 5. Extra nitrogen needed.**

$$\begin{aligned}\text{Extra nitrogen (from a table)} &= \text{N needed to grow the crop} - \text{Available N in the soil} - \text{In-crop mineral N (from a table)} \\ &= \underline{\hspace{2cm}} \text{ kgN/ha} - \underline{\hspace{2cm}} \text{ kgN/ha} - \underline{\hspace{2cm}} \text{ kgN/ha} \\ &= \underline{\hspace{2cm}} \text{ kgN/ha}\end{aligned}$$

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**Further information**

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## ESTIMATING NUTRIENT LOSS AND ACIDIFICATION RATES

**James Fisher**

**Centre for Cropping Systems,  
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### Introduction

Many farmer groups have been monitoring performance of crops for several years and/or may have identified crop nutrition or soil acidification as a problem in their area. Some members may conduct audits of nutrients, or seek such information through soil testing or consultancy services.

Once a group has identified the need for an audit of nutrient losses and replacement, the *Lime and Nutrient Calculator* (LNC) developed for use in Western Australia, provides a means of learning about this topic. Agriculture Western Australia has successfully run workshops in many locations throughout Western Australia. The activity is highly participatory, and farmers calculate the nutrient balances of their paddocks using their own crop monitoring data. The workshops include analysis and discussion of results, a field visit and discussion of symptoms of crop nutrient deficiencies for local crops.

### Workshop process

#### Planning

Following request for a workshop on this topic, the facilitator (trained in use of the LNC) will need to make contact with the group to understand their particular needs (e.g. local nutrient problems, acidification). They will need to decide on a suitable venue and best timing for the workshop (e.g. while crops and nutrient deficiency symptoms are visible, when farmers are ordering fertilisers or lime).

Visit the area and select farm and paddock(s) close to the venue. Obtain 3–5 years cropping records for the paddocks to be visited. Prepare a notice about the workshop for distribution by the group or local agent. Ensure that participants are asked to bring 2–5 years of data on crops, fertiliser applications and yields, from one or two paddocks on their farm.

### Objective

To enable participants to estimate losses of nutrients and rates of acidification from their crop rotations, and hence to plan for sustainable production

### Other learning outcomes

- Competency in use of both printed and computer versions of the Lime and Nutrient Calculator to estimate removal of nutrients with rotations
- Ability to use the calculator with other measurements and tests (e.g. lime) to assist with management decisions regarding nutrients
- Ability to identify in the field, poor crop growth due to nutrient deficiency

### Tool type

- Half-day workshop at a suitable venue, with visit to local paddock(s). Use of Calculator/tool. Conducted by agronomist.

### Materials

- Copy of *Lime and Nutrient Calculator* (LNC) for each participant
- Computers and copies of LNC software for participants
- Suitable venue for workshop and computer use
- Suitable paddock for field visit, with five years (crop & fertiliser) data
- Participants' own cropping data for 2–5 years from two paddocks
- Spare sets of example data for those who forget to bring their own
- Tables and slides of nutrient deficiency symptoms in main crops
- Data projector and screen, whiteboard and markers, paper and pens
- Copies of participant evaluation sheets
- Refreshments

### Field visit

The field visit starts with a visit to a selected paddock, where farmers are introduced to the facilitator and each other if needed. The aims of the workshop are clearly stated, and a program for the morning is distributed. Questions about aims and workshop agenda are taken.

If crops are available, examine crops with and without deficiency symptoms. Discuss approaches to assessing nutrient losses and fertiliser needs of each paddock. Discuss the use of calculations in the decision-making process. Ask for local experience of nutrient deficiencies, lime use and of using tissue and soil testing and nutrient auditing.

### Group calculations: indoor activity

1. Distribute copies of LNC. Briefly introduce it.
2. Work through an example, using information from the field visit. This is done by working through the steps of the calculation with minimum clarification.
3. Describe the meaning of the result and how it can be used.
4. Work through a different example with participants allowing time for discussion and clarification, and explaining some of the background behind the calculator and its components.
5. Complete one of the calculations, using the computer version of the LNC.
6. Include some 'what-if' scenarios to demonstrate effect of changing yield, fertiliser, rainfall, etc.
7. Refreshment break.
8. Encourage participants to work through data from their own paddocks. The facilitator will need extra sets of data for those without their own information. Include discussion of results, and any problems from previous session.

### **MAIN DOS AND DON'TS**

- ✓ Do have an example that is pertinent for the local area.
- ✓ Do check that the program runs on all computers.
- ✗ Don't take too long working through the first example. Use this to work through the process and discuss the detail/assumptions in further examples.
- ✓ Do reinforce that the calculator should be used in conjunction with other information.

Figure 1. Sample output from the computer version of the *Lime and Nutrient Calculator*.

**Your Rotation**

Please enter information for 2000

Crop & Yield  
Crop / Product: wheat Yield: 2.2  
The units for the yield figure are:  
t/ha for crops  
kg/ha for wool (greasy) and meat (live weight)

Rainfall this year (if not average): 325-450  
Rainfall distribution:  
☐ Even ☒ Normal ☐ Wet/Dry

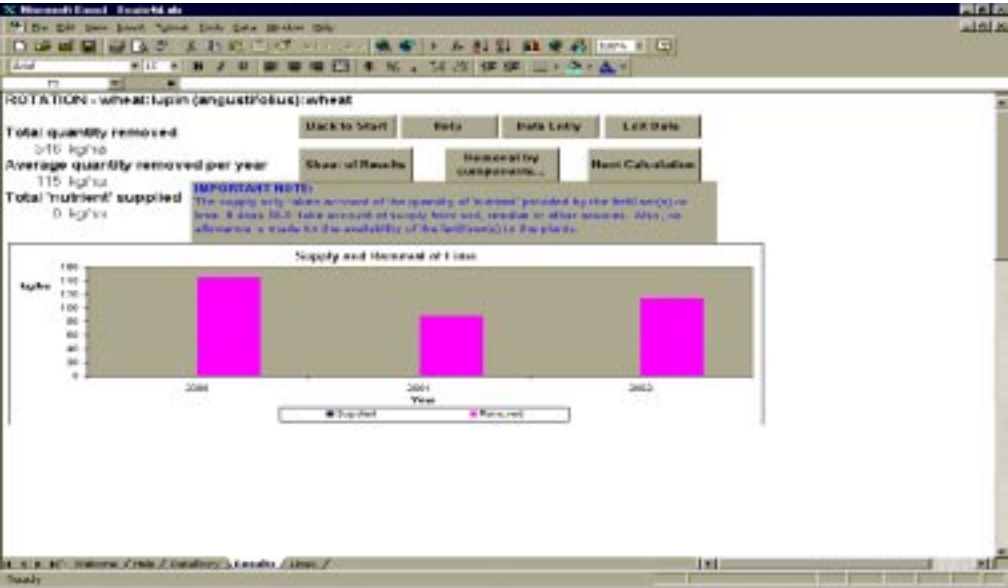
For conversions:  
bags/acre to t/ha: 3 0  
lb/acre to kg/ha: 3 0

Fertilisers applied (kg of fertiliser or lime per ha)  
Notes: rates are automatically rounded to nearest 5 kg for calculation(s)

| Fertiliser 1 | Rate 1 | Fertiliser 2 | Rate 2 | Fertiliser 3 | Rate 3 |
|--------------|--------|--------------|--------|--------------|--------|
| <None>       | 30     | <None>       | 30     | <None>       | 30     |
| Fertiliser 4 | Rate 4 | Fertiliser 5 | Rate 5 | Fertiliser 6 | Rate 6 |
| <None>       | 30     | <None>       | 30     | <None>       | 30     |

Buttons: Continue, Cancel

1. Input dialogue box for entering information about a rotation



2. Output for the rotation

Microsoft Excel - Worksheet: Results

Results

| Year | Crop  | Harvested (kg/ha) | Residual (kg/ha) | Available (kg/ha) | Required (kg/ha) | Excess (kg/ha) |
|------|-------|-------------------|------------------|-------------------|------------------|----------------|
| 2000 | wheat | 0                 | 0                | 0                 | 115              | -115           |
| 2001 | wheat | 0                 | 0                | 0                 | 115              | -115           |
| 2002 | wheat | 115               | 115              | 115               | 115              | 0              |

3. Output for each year of the rotation

9. Conclusion. Reinforce that the calculator is used to estimate the rate at which a nutrient is being depleted and should be used in conjunction with other information (soil and tissue tests) to formulate rates of fertiliser (and lime) application.
10. Evaluation and feedback. Ask participants to complete the evaluation sheet for the workshop. This should include ideas on value of session, how the session could be improved and whether they will use the LNC in the future.

### Resources

The *Lime and Nutrient Calculator* is currently available through TopCrop in Western Australia.

The development of the calculator was a cooperative project between the Centre for Legumes in Mediterranean Agriculture and Agriculture Western Australia. The Grains Research and Development Corporation kindly supported the project.

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### Further information

- . Carol Llewellyn
- TopCrop West
- c/- Centre for Cropping Systems
- Agriculture Western Australia
- PO Box 483, Northam, Western Australia 6401

## IDENTIFYING CEREAL LEAF DISEASES

**Frank Henry**  
**Crop Doctor Diagnostics**

### Introduction

Many farmers have difficulty identifying foliar diseases. Incorrect disease identification often results in inappropriate management strategies and substantial yield losses.

### How to use the disease management tool

#### Preparation of plant samples

- Ask farmers what they consider to be the main disease problems in their region.
- Identify paddocks with relevant cereal leaf diseases during the growing season.
- Collect plant samples from selected paddocks one or two days prior to the workshop.
- Store samples in a fridge until the workshop.

### Workshop

The workshop should be conducted during the growing season when disease problems are present in crops. Each workshop should be small enough so that all participants receive personal instruction (15 to 20 people is ideal). Allow a day for its completion.

#### Introduction and slide show of disease symptoms (theory)

1. Introduce the topic by listing each disease covered. Explain the objectives of the workshop.
2. Concentrate on one disease at a time, and outline the symptoms for that particular disease. Use slides or posters to show examples of disease symptoms. Refer to pictures in Right Rotations pamphlet too.
3. Encourage discussion about farmers' experience of each disease. Ask a question on each disease to stimulate interest. Use the whiteboard to record answers. After explaining the symptoms for each disease, explain the concept of scoring plant specimens for severity of disease, and then move to the practical exercise.

### Objective

Enable farmers to identify common foliar diseases and understand disease cycles.

Help new extension officers train farmers in disease management.

### Tool type

- A one-day workshop based on Right Rotations program and manual. Uses plant samples collected by facilitator prior to meeting for examination by the group.

### Crops

- Wheat, barley, oats, triticale

### Diseases

- Rusts (leaf, stem & stripe), Bunts (common, loose & flag) and barley yellow dwarf virus. Wheat diseases: *Septoria (nodorum and tritici)*, yellow leaf spot. Barley diseases: scald, net blotch, spot form of net blotch, powdery mildew.

### Materials

- Venue: usually a hall, shearing shed or CFA fire station. Decide on which other facilities are needed (e.g. child minding, toilets)
- Overhead projector, slide projector, daylight screen, slides or posters showing disease symptoms
- Whiteboard and pens, pencils for disease scoring, disease scorecards (see Tables 1 & 2)
- Maggy lamps or magnifying glasses (important as some farmers have poor eyesight)
- Tables (usually found in the venue), white trays ~ 45x30x6 cm for examining disease symptoms
- Right Rotations disease identification guides (one per farmer) and references showing disease symptoms (developed by South Australian Research and Development Institute for the Ag Bureau)

### 'Hands-on' disease identification

1. Place specimens of diseased plants in white trays, and set up a number of stations, one for each disease. Make sure each station is numbered and in good light (outside if possible).
2. Hand out disease scorecards (see Tables 1–3) and the Right Rotations disease identification pamphlet. Ask farmers to walk around the room and examine the plant specimens at each station (white tray). Farmers should score 10 plants for disease at each station, using the books available.

Farmers will need help with disease identification and scoring. Move around the group and provide assistance. After the disease scorecards are completed, average the disease scores and provide the farmers with the results.

3. Have a ten-minute break before starting the disease management stage to give farmers the opportunity to think about the topic.

### Disease management (theory)

1. Show farmers how to manage different disease problems.  
The results from the disease identification exercise provide a good opportunity to start a discussion.
2. Work through each disease. Describe multiplication and over-summering (survival). Explain to farmers that the amount of disease that survives between seasons is dependent on management and environmental conditions over the summer and in the autumn. Use slides to explain disease cycles.
3. Discuss control methods for each disease. Include information on topics such as rotations, tillage, stubble management, fungicides, seed dressings and resistant varieties. Ensure farmers know that resistance does not mean immunity.

### Summarise management practices for each disease.

1. After the practical exercise and a break, ask questions to stimulate discussions on each disease. Write the answers on the whiteboard. Link the disease cycle to management.
2. Repeat this exercise for all diseases included in the workshop. At the end of the workshop, summarise disease symptoms and management strategies for each disease.

### Workshop evaluation

1. Conclude by evaluating what farmers have learnt during the day. Ask each farmer how they will apply their understanding of disease cycles to management practices. Use a scenario to stimulate discussion.



Specimens of diseased crop plants are brought in from paddock to the workshop venue

## CHECK LIST

- ✓ To stimulate interest in the workshop ask farmers personally to bring samples of diseased crop plants in plastic bags to the workshop, for identification by the group.
- ✓ Conduct the identification component of the workshop in sunlight, because disease symptoms are difficult to see inside a dark hall or shearing shed.
- ✓ Have an assistant to help with the practical session.
- ✓ Ensure reference books are available for farmers to look at during the workshop.
- ✓ Set up white trays with plants that show different disease symptoms.
- ✓ Encourage all farmers to work out identifications themselves.
- ✗ Do NOT conduct workshops at night or in limited light.

## Resources

Right Rotations disease identification guide for leaf and stem diseases and Top Crop (Right Rotation) disease identification posters are available from Jon Lamb Communications, 81 Fourth Avenue, St Peters, Adelaide, South Australia.

Disease identification slide set. Available from the Victorian Institute for Dryland Agriculture, PO Bag 260, Horsham, Victoria 3400.

Wallwork, Hugh (ed.) 1992. Cereal Leaf and Stem Diseases. Kondinin Group. ISBN 0 642 182451 8.

**Table 1.** Sample disease recording sheet for wheat. The disease recording sheet should be used in conjunction with the Right Rotations disease identification guide for cereal leaf and stem diseases.

| Sample no. | Stripe rust | Leaf rust | Yellow leaf spot | Septoria leaf blotch | Other |
|------------|-------------|-----------|------------------|----------------------|-------|
| 1          |             |           |                  |                      |       |
| 2          |             |           |                  |                      |       |
| 3          |             |           |                  |                      |       |
| 4          |             |           |                  |                      |       |
| 5          |             |           |                  |                      |       |
| 6          |             |           |                  |                      |       |
| 7          |             |           |                  |                      |       |
| 8          |             |           |                  |                      |       |
| 9          |             |           |                  |                      |       |
| 10         |             |           |                  |                      |       |
| Average    |             |           |                  |                      |       |

Disease rating based on 0–5 scale.

0 = no disease

5 = severe

**Table 2.** Sample disease recording sheet for barley. The disease-recording sheet should be used in conjunction with the Right Rotations disease identification guide for cereal leaf and stem diseases.

| Sample no. | Scald | Net blotch | Spot form of net blotch | Powdery mildew | Other |
|------------|-------|------------|-------------------------|----------------|-------|
| 1          |       |            |                         |                |       |
| 2          |       |            |                         |                |       |
| 3          |       |            |                         |                |       |
| 4          |       |            |                         |                |       |
| 5          |       |            |                         |                |       |
| 6          |       |            |                         |                |       |
| 7          |       |            |                         |                |       |
| 8          |       |            |                         |                |       |
| 9          |       |            |                         |                |       |
| 10         |       |            |                         |                |       |
| Average    |       |            |                         |                |       |

Disease rating based on 0–5 scale.

0 = no disease

5 = severe

**Table 3.** Sample of a scale to assess the severity of cereal leaf diseases. Examine the top four fully expanded leaves on all tillers and make an overall assessment of disease severity. Do not assess naturally senescing leaves.

| Disease severity                                                    | Leaf area affected % | Rating |
|---------------------------------------------------------------------|----------------------|--------|
| No obvious lesions                                                  | 0                    | 0      |
| A few disease lesions, leaves green                                 | 1–5                  | 1      |
| Lesions obvious and forming patches, overall colour of leaves green | 6–10                 | 2      |
| Lesions occupying up to one quarter of the leaf area                | 11–25                | 3      |
| Lesions occupying up to one half of the leaf area                   | 26–50                | 4      |
| Lesions occupying more than half of the leaf area                   | >50                  | 5      |

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## CEREAL ROOT DISEASES: TOOLS, TRICKS AND TIPS FOR IDENTIFICATION

**Frank Henry**  
**Crop Doctor Diagnostics**

### Introduction

Root disease in cereals is regarded as the most serious constraint to management in many dryland cropping areas. Many farmers have difficulty identifying important soil-borne diseases. Incorrect disease identification often results in inappropriate management strategies and substantial yield losses.

### Use of disease management workshops

These workshops have been used across dryland Victoria to help new extension officers train farmers in disease management. A specialist in crop diseases is essential for this activity, but much of the preparation for the workshops can be done by others.

#### Preparation of plant samples for the disease identification workshop

- . Ask farmers what they consider to be the main disease problems in the their region.
- . Identify paddocks with relevant soil-borne disease problems during the growing season.
- . Collect plant samples from selected paddocks one or two days prior to the workshop.
- . Wash dirt from the roots of the plant samples. Make sure the samples are clean.
- . Prepare bundles or bags of plants for the workshop. Each bundle should include plants with different disease symptoms, as well as healthy plants. Twenty plants per bundle should be adequate.
- . Store samples in a fridge until the workshop.

### The workshop

The workshop should be undertaken during the growing season when disease problems are present in crops; this is generally 10 to 12 weeks after sowing. The size of each workshop should be small enough so that all participants receive personal instruction (15 to 20 people is ideal).

### Objective

Enable farmers to identify common soil-borne cereal diseases and understand disease cycles.

### Tool type

- . A one-day workshop based on the Right Rotations program and identification guide. Run by a specialist in crop disease who provides the diseased plant samples.

### Crops

- . Wheat, barley, oats, triticale

### Diseases

- . Take-all, rhizoctonia root rot, cereal cyst nematode (CCN), common root rot, crown rot, and root lesion nematode (*Pratylenchus neglectus* and *P. thornei*).

### Materials

- . Venue (usually a hall, shearing shed or CFA fire station). Decide on which other facilities are needed (e.g. child minding, toilets).
- . Overhead projector, slide projector, daylight screen, slides or posters showing disease symptoms.
- . Whiteboard and pens, pencils for disease scoring, disease scorecards (see Table 1).
- . Maggy lamps or magnifying glasses (important as some farmers have poor eyesight).
- . Tables (usually found in the venue).
- . White trays ~ 45x30x6 cm for examining disease symptoms (at least one tray per two participants).
- . Buckets of water, for cleaning samples and filling the trays.
- . Right Rotations disease identification guides (one per participant) and references showing disease symptoms.

#### Introduction and slide show of disease symptoms (theory)

1. Introduce the topic by listing each disease covered. Explain the objectives of the workshop.
2. Concentrate on one disease at a time, and outline the symptoms for that particular disease. Use slides or posters to show examples of disease symptoms. If possible, show symptoms of disease damage in the paddock and on plant roots.
3. Ask a summary question on each disease to stimulate discussion. Use the whiteboard to record answers. After explaining the symptoms for each disease, move to the practical exercise.

#### Practical 'hands-on' disease identification exercise

1. Organise participants into groups of two or three. Provide each group with a white tray and a bundle of plant samples. Ask them to pour 25 mm of water into the white tray.
2. Start this session by holding up a cereal plant. Explain the different parts of the root system (e.g. primary and secondary roots, sub-crown internode). Ask each participant to examine a plant.
3. Hand out the disease scorecards and the Right Rotations pamphlet with the disease rating scale (see Table 1). Show participants how the rating scale works, and how to score each plant for root disease.
4. Ask participants to examine the plants in their bundle. Tell them to work with one plant at a time and float plant roots in the white trays.
5. Participants will need help with disease identification. Move around the group and provide assistance. After the disease scorecards are completed, average the disease scores and provide participants with the results.
6. Have a 10-minute break before starting the disease management stage to give participants the opportunity to think about disease management, before moving into the disease management session.

**Table 1.** Sample disease recording sheet: The disease recording sheet should be used in conjunction with the Right Rotations disease identification guide for cereal root diseases.

| Sample no | CCN | Take-all | <i>Rhizoctonia</i> | <i>Pratylenchus</i> | Other |
|-----------|-----|----------|--------------------|---------------------|-------|
| 1         |     |          |                    |                     |       |
| 2         |     |          |                    |                     |       |
| 3         |     |          |                    |                     |       |
| 4         |     |          |                    |                     |       |
| 5         |     |          |                    |                     |       |
| 6         |     |          |                    |                     |       |
| 7         |     |          |                    |                     |       |
| 8         |     |          |                    |                     |       |
| 9         |     |          |                    |                     |       |
| 10        |     |          |                    |                     |       |
| Average   |     |          |                    |                     |       |

Disease rating based on 0–3 scale

0 = no disease, 1 = slight, 2 = moderate, 3 = severe,

### Disease management session (theory)

1. Discuss with participants how to manage different disease problems.
2. The results from the disease identification exercise provide a good opportunity to start a discussion.
3. Work through each disease. Describe multiplication and over-summering (survival). Explain that the amount of disease that survives between seasons is dependent on management and environmental conditions over the summer and in the autumn. Use slides to explain disease cycles.
4. Discuss participants' experience with control methods for each disease. Include information on rotations, break crops, tillage, stubble management and resistant varieties. Explain the difference between resistant and tolerant varieties. Ensure participants know that resistance does not mean immunity.
5. Summarise management practices for each disease. Ask questions to stimulate discussions on each disease. Write answers on the whiteboard. Link disease cycles to management.
6. Repeat this exercise for all diseases included in the workshop. At the end of the workshop, summarise disease symptoms and management strategies for each disease.

### Workshop evaluation.

1. Finish the workshop by evaluating what farmers have learnt during the workshop. Ask farmers how they can apply their understanding of disease cycles to management practices. Use a scenario to stimulate discussion.

### **CHECK LIST**

To stimulate interest in the workshop asks farmers to bring disease samples for identification.

- ✓ Ensure plant roots are washed thoroughly. Dirty samples are difficult to assess.
- ✓ Samples collected from sandy soils are easier to clean than samples collected from clay soils.
- ✓ Conduct the identification component of the workshop in sunlight, because disease symptoms are difficult to see inside a dark hall or shearing shed.
- ✗ Do NOT conduct workshops at night.
- ✓ Have an assistant to help with the practical session.
- ✓ Ensure reference books are available for participants to consult during the workshop.
- ✓ Set up white trays with plants that show different disease symptoms.

## Resources

Right Rotations disease identification guide for cereal root diseases and Top Crop (Right Rotation) disease identification posters available from Jon Lamb Communications, 81 Fourth Avenue, St Peters, Adelaide, South Australia.

Disease identification slide set. Available from the Victorian Institute for Dryland Agriculture, PO Bag 260, Horsham, Victoria 3400.

Wallwork, Hugh (ed.) 1996. Cereal Root and Crown Diseases (Revised Edition). Kondinin Group. ISBN 1 876 068 03 5

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Participants examine and score diseased specimens for root diseases.

## AGRICULTURAL WEED IDENTIFICATION WORKSHOP

**Michael Moerkerk**

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### Introduction

Agricultural weeds represent the most serious form of resource degradation in Victoria, and sound weed control is the most expensive input on many cropping farms. Effective weed control depends on a number of factors. One key factor is knowing your weeds and being able to identify them as early as possible to allow the maximum time to implement management strategies.

### Example use of the tool

The activity is one of two workshops developed by the TOPCROP Program for farmers and land managers. The workshop assists participants in identifying seedling weeds in agricultural situations. It has been delivered to farmer groups, chemical resellers and company staff, as well as students in university and TAFE systems. The activity has been successfully used over the last seven years to develop skills and awareness about weeds throughout southern and western Australia, and has been nationally accredited as part of a training course, by Murrumbidgee Agricultural College.

### The participatory process

#### Steps in the weed identification workshop:

1. Brief introduction of participants
2. Broad-leaf seedling weed identification and the features of seedlings that can be used for accurate identification, including plant parts, shapes and hairs. A series of colour overheads of weeds are used as examples of features discussed.
3. Introduction to a simple key to assist in identification of broad-leaf weed seedlings.
4. Practical session, in which participants, working in groups of 3–5, identify numbered seedlings (grown in punnets) using a variety of methods.
5. Participants then identify broad leaf weeds in a number of mixed trays of seedlings collected from paddock in the local area.
6. Lunch break.

### Objectives

To improve competency in plant identification, as the basis for the adoption of sound weed management practices

To assist participants improve skills in *seedling weed* identification

To increase awareness about weeds that grow outside the participants' local area and which have the potential to invade such areas.

### Other learning outcomes

- At the completion of the workshop participants will be able to identify seedling weeds by a number of techniques, including field recognition, description matching and using simple keys.

### Tool type

- Facilitated workshop, conducted by trained instructor, with comprehensive support material (see list below).
- Up to 30 participants over 8 contact hours; delivered over one day.
- Instructors must undertake a two-day instructor training workshop.

### Materials

- Weed Identification Training Module Instructor Kit and associated resources. Available from:  
Secretariat, Farrer Centre, Charles Sturt University  
Locked Bag 588, Wagga Wagga NSW 2678  
Telephone: (02) 6933 2177; Fax: (02) 6933 2924  
Email: jhkent@csu.edu.au

7. Afternoon sessions follow the same structure as the morning sessions but the focus is on narrow leaf seedlings, particularly grasses.
8. Following the afternoon practical session, a simple test is conducted to assess participant skills and knowledge in seedling weed identification. This consists of identifying 9–12 broad leaf and 9–12 narrow leaf seedlings in 40 minutes.
9. The participants, as a conclusion to the workshop, evaluate the test results and the workshop.

#### **Weed identification workshop kit**

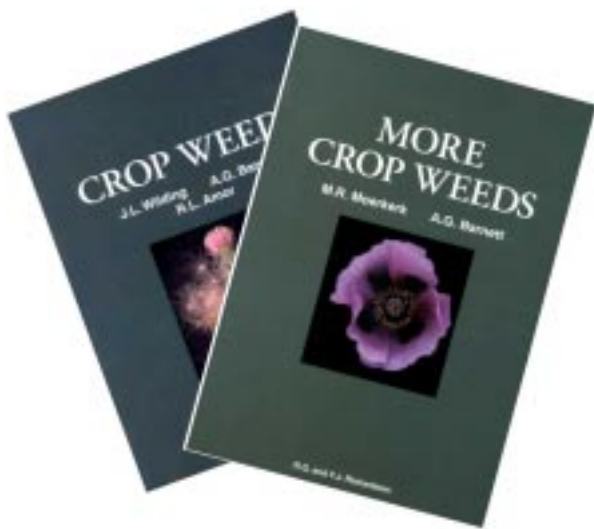
The weed identification workshop kit consists of:

- Weed identification workshop notes
- *Crop Weeds* by Wilding, Barnett and Amor
- *More Crop Weeds* by Moerkerk and Barnett
- 10x hand lens
- Calico bag

#### **Contents of the instruction kit**

The kit is available from the CRC for Weed Management Systems, following successful completion of a two-day instructor training course. It consists of a four ring binder containing:

- Guidelines for instructors
- A set of masters for overheads
- CD-rom of images of seedling weeds
- Information on growing seedlings



Key references supplied as workshop resources.

- A copy of weed identification workshop notes
- A copy of *Crop Weeds* by Wilding, Barnett and Amor
- A copy of 'More Crop Weeds' by Moerkerk and Amor
- 10x hand lens
- Calico bag

Some useful additions to current instructions in kit

- set of named seedling plant material for use in the workshop
- set of mixed sward plant material used in the workshop
- test trays for participants assessment
- overhead projector/screen

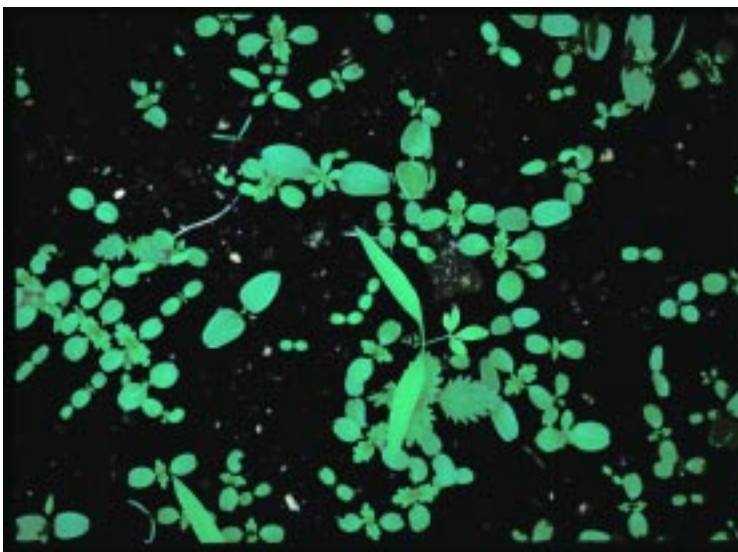
A full list is provided once instructors undertake the instructor-training course.

### Workshop accreditation and participant certification

The weed identification workshop forms 50% of a short course in Agricultural Weed Identification/Management, which is based on a number of industry competencies.

The learning outcomes covered by the workshop have been accredited through the Murrumbidgee College of Agriculture and have National recognition.

Participants successfully completing the Weed Identification Workshop (WID01) (including an assessment task) receive a certificate of participation. Those who go on to successfully complete the Weed Management Workshop (WID02) will receive a certificate in Agricultural Weed Identification/Management.



Example of mixed weed seedlings.

### SOME KEY POINTS IN PROMOTING SOUND PARTICIPATION

- ✓ Don't take too long working through the first example. Use this to work through the process and discuss the detail/assumptions in further examples.
- ✓ Ensure that locally important weeds are represented.
- ✓ Include some weed seedlings that do and some that do not key-out easily in keys provided
- ✓ Use healthy, good quality plant material
- ✓ Ensure plenty of natural light in the venue or very good artificial light
- ✓ Make sure there is sufficient time for the prac sessions as these are always rated highly by participants
- ✓ Circulate and assist participants in their working groups by demonstrating identification techniques.
- ✓ Share techniques and ideas that are raised

**Further information**

- . The Farrer Centre  
Charles Sturt University  
Locked Bag 588  
Wagga Wagga, New South Wales 2678  
Telephone: (02) 6933 2177; fax: (02) 6933 2924  
Email: [jhkent@csu.edu.au](mailto:jhkent@csu.edu.au)
  
- . Michael Moerkerk  
Victorian Institute for Dryland Agriculture  
Private Bag 260  
Horsham, Victoria 3401  
Telephone: (03) 5362 2111; fax: (03) 5362 2187  
Email: [michael.moerkerk@nre.vic.gov.au](mailto:michael.moerkerk@nre.vic.gov.au)

## INTEGRATED WEED MANAGEMENT WORKSHOP

**Michael Moerkerk**

**Agriculture Victoria, Victorian Institute for Dryland Agriculture, Horsham, Victoria**

### Introduction

This tool is the second in a series of two workshops, developed by Agriculture Victoria, GRDC and the CRC for Weed Management Systems for TOPCROP and other groups for use with farmers and land managers with a common weed problem. Developing a sound understanding of the biology/ecology, management options and management strategies for long-term control is the key to successful implementation of integrated weed management. The activity has been successfully used to develop examples of management strategies for muskweed in the Wimmera of Victoria, fumitory in Southern NSW and wild garlic in central Victoria.

### Workshop process

#### Prior to workshop session

1. Decide on a focus weed either through discussion with some potential participants, by contacting a local reseller/agronomist or asking a group of farmers which weed they would like to focus on in a particular area. Alternatively the instructor may decide on the target weed and advertise that workshops will be held on that weed at a given time. It is important that all participants know which is the target weed.
2. Participants register for the workshop and receive the workshop kit 2–3 weeks prior to the workshop date
3. Participants are asked to attempt a number of work sheets to help them develop and collate the background material necessary for a successful workshop.
4. Participants bring their completed work sheets to the workshop session as they help in developing a sound understanding of the target weed.

### Objectives

To assist participants improve skills in weed management by building on their own experiences and sharing experiences of others.

To identify long-term weed management strategies, assess the best strategy for participants' property or local agricultural system.

To provide a forum for networking and resource sharing.

### Other learning outcomes

- At the completion of the workshop, participants will be able to define the meaning of a weed, describe the potential impact of weeds in a selected situation, describe chemical, cultural and biological weed management techniques and establish a weed management plan in an identified situation.

### Industry outcomes

- Workshop outcomes will assist the grains industry in developing information packages on the management of target weeds, identify current industry practice in weed management and identify further research and extension priorities.

### Tool type

- Facilitated workshop by trained instructor with comprehensive support material.
- 10–20 participants, flexible delivery mode 1, 2 or 4 sessions, 8 contact hours.
- Pre-requisite for participants: reading and exercises/work sheets
- Pre-requisite for instructors: satisfactory completion of a one-day instructor training workshop.

### Materials

- Weed Management Training Module Instructor Kit and associated resources. Available from:  
Secretariat, Farrer Centre, Charles Sturt University  
Locked Bag 588 Wagga Wagga, NSW 2678  
Telephone: (02) 6933 2177; fax: (02) 6933 2924  
Email: jhkent@csu.edu.au

**WORK SHEET 2 - PROBLEMS AND BENEFITS**

This work sheet is designed to assist you in developing a clear picture of the problem the target weed/weed complex creates in your farming system. Tick the box if you think the weed has the attributes listed and if you can make a comment where space is provided.

**Problems:** (Reference: Chapter 5 *Weed Management Workshop Notes*)

|                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Poisonous plant parts</b></p> <p><input type="checkbox"/> Roots<br/><input type="checkbox"/> Leaves<br/><input type="checkbox"/> Stems<br/><input type="checkbox"/> Flowers<br/><input type="checkbox"/> Seeds<br/><input type="checkbox"/> Fruits<br/><input type="checkbox"/> Whole plant</p> <p><b>Poisonous chemical/chemicals</b></p>                                | <p><b>Miscellaneous</b></p> <p><input type="checkbox"/> Fire risk<br/><input type="checkbox"/> Aesthetic problem<br/><input type="checkbox"/> Threat to bio-diversity<br/><input type="checkbox"/> Recreational value<br/><input type="checkbox"/> Other</p>                                                                                    |
| <p><b>Noxious plant parts</b></p> <p><input type="checkbox"/> Stems<br/><input type="checkbox"/> Leaves<br/><input type="checkbox"/> Seeds<br/><input type="checkbox"/> Fruits</p> <p><b>Noxious agent/s:</b></p> <p><input type="checkbox"/> Spines/thorns<br/><input type="checkbox"/> Sap<br/><input type="checkbox"/> Stinging hairs<br/><input type="checkbox"/> Other</p> | <p><b>Contaminates produce</b></p> <p><input type="checkbox"/> Human consumption<br/><input type="checkbox"/> Export<br/><input type="checkbox"/> Domestic<br/><input type="checkbox"/> Stock feed<br/><input type="checkbox"/> Export<br/><input type="checkbox"/> Domestic</p> <p>Tolerances for different crops (list)</p> <p>Seed crops</p> |
| <p><b>Restricts movement</b></p> <p><b>Machinery</b></p> <p><input type="checkbox"/> Public access<br/><input type="checkbox"/> Stock<br/><input type="checkbox"/> Other</p>                                                                                                                                                                                                    | <p><b>Impedes harvesting</b></p> <p><input type="checkbox"/> Moisture<br/><input type="checkbox"/> Requires desiccation<br/><input type="checkbox"/> Rate of harvest. How?</p> <p><input type="checkbox"/> Clogs machinery ( sticky, bulky)<br/><input type="checkbox"/> Can't clean out of sample</p>                                          |

Example of work sheets used in the weed management workshop.

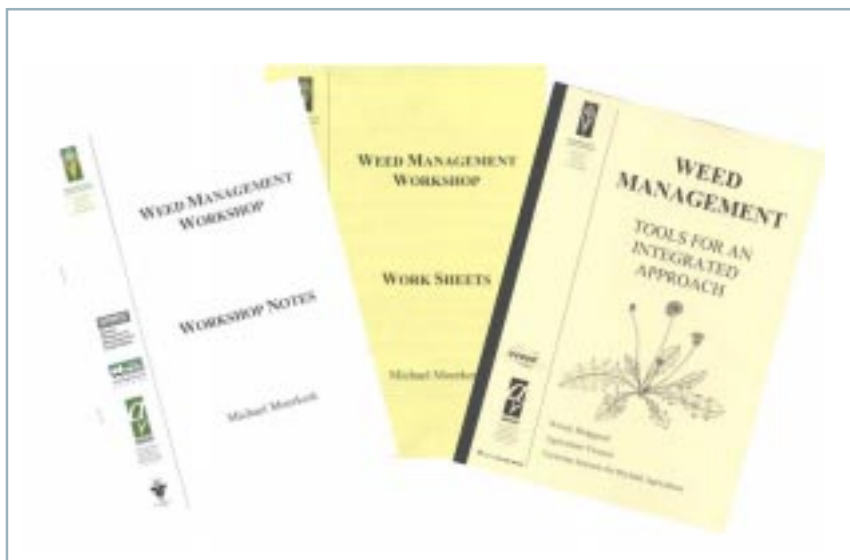
### Weed management workshop

5. Brief introduction to the target weed based on information in the literature. Includes information on the origin of the weed, nomenclature, identification, significance as a weed, problems and benefits and may include some management techniques. Information is provided in overhead format.
6. Participants share experiences regarding the problems the weed creates in their system. They are asked to briefly talk about one problem the weed creates.
7. Participants share their experiences and observations regarding the biology and ecology of the weeds.
8. Participants discuss experiences with successful weed management options in sufficient detail to allow others to repeat the method.
9. Participants discuss failed weed management options, the reasons that they considered these a failure, and what could be done to turn these into successful options.
10. Members participate in a brainstorm session to develop new ideas that may be worth trying to improve the management of the target weed.
11. Participants prepare a number of examples of integrated weed management strategies for situations put forward by the group. Aspects covered include current situation statements, history of the situation, five and ten-year goals and the keys to achieving these, development of different management options based on information discussed throughout the workshop.

### **The weed management workshop kit**

The weed management workshop kit consists of:

- copies of seven work sheets
- workshop notes
- *Weed Management Tools for an Integrated Approach* by Wendy Bedggood



Contents of the weed management workshop kit

### **Instructors kit**

The instructors kit, is available from the CRC for Weed Management Systems following successful completion of a one-day instructors training course. It consists of a four-ring binder containing:

- guidelines for instructors
- a series of appendices including recording sheets
- introductory overheads
- CD-rom of appendices
- a copy of the work sheets
- workshop notes
- *Weed Management Tools for an Integrated Approach* by Wendy Bedggood

### **Additions needed to current instructions in booklet**

- Information regarding the target weed species or situation (available by contacting Michael Moerkerk at VIDA) will be available on a website in the next 12 months.
- To deliver the weed management workshop instructors are to successfully complete an instructor training course conducted by the CRC for Weed Management Systems.

A full list of additional requirements of instructors is provided once instructors undertake the instructor training course.

**Further information**

- . The Farrer Centre  
Charles Sturt University  
Locked Bag 588  
Wagga Wagga, New South Wales 2678  
Telephone: (02) 6933 2177; fax: (02) 6933 2924  
Email: [jhkent@csu.edu.au](mailto:jhkent@csu.edu.au)
  
- . Michael Moerkerk  
Victorian Institute for Dryland Agriculture  
Private Bag 260  
Horsham, Victoria 3401  
Telephone: (03) 5362 2111; fax: (03) 5362 2187  
Email: [michael.moerkerk@nre.vic.gov.au](mailto:michael.moerkerk@nre.vic.gov.au)

## RYEGRASS INTEGRATED MANAGEMENT MODEL (RIM)

**Vanessa Stewart**  
**Agriculture Western Australia**

### Tool developed by

David Pannell, Vanessa Stewart, Anne Bennett, Marta Monjardino, Carmel Schmidt and Stephen Powles

University of Western Australia, Agriculture Western Australia, Western Australian Herbicide Resistance Initiative, Grains Research and Development Corporation

### Introduction

Herbicide resistance is an increasing problem throughout the Western Australian wheatbelt and other parts of Australia. As a result, many farmers are having to reassess their weed management practices and consider new options. Growers are frequently looking to both the public and private sectors for agronomic advice on the management of herbicide resistant weeds.

The solutions to this problem rely on integrating the use of different weed management techniques, but it is often difficult to give comprehensive advice on the impact that this approach will have on profits and weed management. RIM is designed to help make assessment of the different combinations easier. This tool has been used with farmer and agribusiness groups in Western Australia to demonstrate and test solutions to these issues.

Introduction to RIM is generally in a workshop environment. It is used to complement information delivered on herbicide resistance and/or integrated weed management. Workshops have been held with both farmer and agribusiness groups, and the software has been made widely available. There has been considerable adoption of the program by the agribusiness sector. Consultants and company agronomists have also begun using RIM on a one-to-one basis with farmer clients when planning cropping programs.

### Objectives

To allow farmers and their advisers to investigate the impact of different weed management options on annual ryegrass numbers, enterprise productivity and rotation profitability.

### Learning outcomes

- Increased understanding of principles of integrated weed management
- Broadening of views on annual ryegrass management option possibilities and rotations
- Value of different weed control tools to the farming system.

### Tool type

- A user friendly, bio-economic simulation model used in workshops with farmers who participate by testing various rotations and possible solutions for their farms.
- Copies of RIM (cost \$50 for CD and manual) are available from:  
 Western Australian Herbicide Resistance Initiative  
 Faculty of Agriculture, University of Western Australia,  
 Nedlands, Western Australia 6907

### Materials required

- Computers with Excel, whiteboard or butchers paper, RIM software.

### Further information

- Vanessa Stewart: (08) 9081 3111
- Robert Barrett-Lennard: (08) 9380 7870

### **Introductory workshop on RIM**

RIM workshops with farmers or agribusiness agents are run by trained RIM facilitators, at suitable venues in rural areas. The workshop process consists of the following steps:

1. Select an appropriate venue that has access to one computer for every 2–3 workshop participants.
2. Workshop will begin with introductory talks and discussion on herbicide resistance and integrated weed management. Participants are encouraged to share their experiences with herbicide resistance and provide input on the different control options discussed.
3. Participants are then introduced to RIM, what is in it and how to use it.
4. An example of an on-farm resistance scenario is decided. Once defined the group splits into groups of 2–3 to then design integrated weed management strategies that provide management solutions for the defined scenario.
5. Results are discussed by the group with individual approaches examined and dissected to highlight take home messages.
6. It is normal in a workshop to run through two or three scenarios.

### **How the RIM model works**

RIM is a bio-economic simulation model. This means that it includes the detailed biological and economic relationships that need to be considered when managing annual ryegrass in different enterprises on a Western Australian broadacre farm (its use is not limited to Western Australian conditions).

The user nominates a rotation (enterprise sequence) from a choice of wheat, lupins, canola, barley, volunteer pasture, self regenerating clover and *Cadiz serradella*. There are over 30 weed control options included in the model representing biological, chemical, cultural and mechanical weed control methods. The different options available also target different stages of the weed life cycle from seed to germinating plants, to flowering and to seed set.

The model provides a flexible environment for investigating the impact of weed control choice and rotation on annual ryegrass numbers. It is designed to allow the user to observe the impacts of their weed management decisions over either a 10 or 20-year period. There are no limitations on rotation choice or control option selection of the built-in model options (except to exclude selections that would be nonsensical or impossible).

The key outputs that the model provides are impacts on annual ryegrass numbers as well as annual gross margin returns and an annualised \$/year return for the period and method of weed control investigated.

In the workshop environment the numbers generated from individual selections are the focus points of discussion. Differences in end points are explored and then the methods used to attain the numbers discussed, providing the opportunity to highlight the positives of different strategies investigated.

### **RIM CD and manual**

RIM is not a stand-alone package. Users must have access to Microsoft Excel® version 95 or later. The CD contains two versions of the program: one saved as an Excel 95 file and the other saved for versions of Excel 97 or higher.

The user manual contains information on what RIM is, hardware and software requirements, an overview of the assumptions of RIM, and detailed descriptions on how to use RIM and the results generated by RIM. Information is also provided on the biological and economic assumptions underlying the model.

### **Participant feedback**

Reaction to RIM has been very positive. Growers are especially appreciative as it is simple to use and contains very detailed information. As management may involve changing rotations or combining many different control options together into a management strategy it is very difficult to track all the impacts that this may have on weed numbers and profit. RIM makes it simple, and provides insights not easy to achieve in other ways.



Participants of Mingenew Irwin Group RIM workshop March 2000. Photo by Vanessa Stewart, Agriculture Western Australia



## BEST BET WINTER PASTURE CLEANING

**Darren Keating, Nick Bate**

**Department of Natural Resources and Environment, Bendigo, Victoria**

### Introduction

Management of pasture paddocks can have a large impact on crop productivity in the following years. Crops grow better in paddocks with good clover/medic histories through:

- higher soil nitrogen levels;
- lower levels of cereal diseases; and
- lower populations of problem weeds.

In north-central Victoria, both on-farm practice and research have found the most reliable way of manipulating pastures to achieve legume dominance is through the use of winter cleaning. The term 'winter cleaning' covers a large range of pasture management options, using different combinations of herbicides and grazing management to achieve legume-dominant pastures.

The TOPACTIVE workshop described in this tool is the second of a series of four complementary modules (see below) released by the TOPCROP network. The modules are focused on the management of paddocks that have existing pasture and are planned to be cropped within the next two years.

The TOPCROP network provides activities, materials and support for all stakeholders in the Australian Grains industry.

### Process

#### Welcome and introduction

Start with an icebreaker; this can vary with the history of the group and whether they know each other. For a well established group, a simple question could achieve this (e.g. ask each member *What do you like about your farm?*). For new groups, or where participants may not know each other, the groups can be asked to create a map of the local area by drawing in their property on a rough map on a piece of butcher's paper. Both these techniques encourage all participants to talk and feel comfortable in the group.

### Objectives

Producers are able to collect data on pasture composition and use this to plan pasture manipulation to achieve a legume dominant pasture. This is done through interactive activities in the workshop that draw on both local experiences from group members, and facilitator knowledge.

### Tool type

- Workshop (indoor and outside), using various materials and participatory exercises.

### Source

- TOPCROP TOPACTIVE module: Pasture Check for Better Crops 2—manipulating pasture for maximum annual pasture legume content

### Materials

- TOPACTIVE group workshop manual
- Whiteboard
- Butchers paper or large post-it notes
- Pasture sticks (as used in PROGRAZE)—1 pasture stick between 2 participants
- Calculator(s)
- Chemical reseller with local knowledge on winter cleaning

### Pasture Check for Better Crops modules

- Pasture Check for Better Crops 1 – Managing Annual Pasture Legume Germination.
- Pasture Check for Better Crops 2 – Manipulating Pasture for Maximum Annual Pasture Legume Content.
- Pasture Check for Better Crops 3 – Pasture Manipulation and Animal Production: Compromise and Flexibility.
- Pasture Check for better Crops 4 – The End of Season Benefits of Pasture Legumes for Cropping.

The introduction session is structured with a series of questions, such as:

- Why would you winter clean?
- Has anyone tried winter cleaning?
- If so, how did it go?
- What are the advantages and disadvantages of winter cleaning?

After the introduction, head out into the paddock and get into the hands-on activities, where the real participation happens.

#### Measuring pasture composition

Pasture composition is measured by the participants using the stick method: throw a stick with a nail in the end; the pasture or weed species the nail hits is then listed on the recording sheet (see Table 1). The group should break into pairs, taking turns to throw the stick and record and ensuring that all group members participate in collecting data.

Collection of their own data rather than using numbers from a distant trial gives the group understanding and ownership of the workshop. In this case the data are the species composition of the pasture.

#### Analysis and diagnosis

The group analyses the paddock data they have collected, use it to diagnose problems and then consider decisions to be made on pasture manipulation. These decisions include:

- Is pasture manipulation an option for this paddock?
- What method of pasture manipulation is appropriate?
- What chemicals could be used?
- What is the 'best bet' option?

The formulation of a series of 'best bet' options, in addition to sharing knowledge between group members, provides a focus point for the next workshop. This is done through a demonstration of the different 'best bet' options as formulated by the group in the paddock. This demonstration then provides a focus for the Pasture Check for Better Crops 3 workshop where the effectiveness and cost of the different treatments can be observed and compared.



Farmers assess pasture condition in small groups.

#### **Timing**

This session is best held 4–6 weeks after the autumn break, or when there has been enough time and moisture for annual seedlings to emerge.

- ✓ Pre-check the paddock to ensure that it is a candidate for winter cleaning (i.e. has some grass and broad leaf weeds) and the manager intends to crop the paddock within the next two years. This keeps the activity real and prevents it from being just a theory session.
- ✓ Ask participants to pair with someone they don't know well when assessing the pasture. This increases communication and ideas sharing within the group.
- ✓ Write down comments or suggestions on paper rather than a white board. Since you cannot just rub it off, participants feel that their comments are valued.
- ✓ Ask for a suggestion for a treatment from each participant.
- ✗ Do not push your own ideas on the group; rather draw ideas from the group. In this way you can learn about the group's perceptions as well as their knowledge.
- ✗ Do not allow the quieter members of the group to be excluded.

| Species                                                       |                                                                                                                                                                                                                                                                                                                                                       | Total         |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Improved grass<br>(ryegrass),<br>phalaris,<br>cocksfoot etc.) | <del>1</del> <del>2</del> <del>3</del> <del>4</del> <del>5</del> <del>6</del> <del>7</del> <del>8</del> <del>9</del> <del>10</del> <del>11</del> <del>12</del> 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                  | 12<br><br>24% |
| Clover or medic                                               | <del>1</del> <del>2</del> <del>3</del> <del>4</del> <del>5</del> <del>6</del> 7 8 9 10 11 12 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                                                                                    | 6<br><br>12%  |
| Weeds (specify)<br>-----                                      | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                                                                                                                                                      | 0             |
| Capeweed<br>erodium or<br>other broadleaf<br>weeds            | <del>1</del> <del>2</del> <del>3</del> 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                                                                                                                     | 3<br><br>6%   |
| Unimproved<br>grasses (bent,<br>onion grass etc.)             | <del>1</del> <del>2</del> <del>3</del> <del>4</del> <del>5</del> <del>6</del> <del>7</del> <del>8</del> <del>9</del> <del>10</del> <del>11</del> <del>12</del> <del>13</del> <del>14</del> <del>15</del> 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 | 15<br><br>30% |
| Annual grasses                                                | <del>1</del> <del>2</del> <del>3</del> <del>4</del> <del>5</del> <del>6</del> <del>7</del> <del>8</del> 9 10 11 12 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                                                              | 8<br><br>16%  |
| Dead pasture                                                  | <del>1</del> <del>2</del> <del>3</del> 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                                                                                                                     | 3<br><br>6%   |
| No pasture,<br>bare ground                                    | <del>1</del> <del>2</del> <del>3</del> 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20<br>21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40<br>41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60                                                                                                                                     | 3<br><br>6%   |

**Further information**

For information on Pasture Check for Better Crops TOPACTIVE workshops:

- . Darren Keating  
Department of Natural Resources and Environment  
Box 3100 Bendigo, Victoria 3554  
Phone: (03) 5430 4371; fax: (03) 5448 4982  
Email: [darren.keating@nre.vic.gov.au](mailto:darren.keating@nre.vic.gov.au)

For further information on TOPCROP try:

[www.nre.vic.gov.au/farming/topcrop/](http://www.nre.vic.gov.au/farming/topcrop/)

## DEVELOPING BEST PRACTICE AMONG LUCERNE GROWER GROUPS

John Whiteley, Geoff Kemister, Peter Orchard  
NSW Agriculture

### Introduction

Where rainfall is erratic and unreliable, the establishment and growth of annual pasture is generally poor, and becomes a major limiting factor in livestock productivity. Experience on farms in the 1994 drought in New South Wales highlighted the value of a perennial plant (e.g. lucerne) which can exploit moisture when it is available and from greater depths than annual pastures in the pasture system. Consequently, in 1995 the Pastures Pay Program of NSW Agriculture decided to target lucerne as a dominant pasture species in the 350–450 mm rainfall cropping zone.

As a means of gaining credibility with the farming community and to seek farmer knowledge and participation in the program, a series of focus group workshops was planned throughout five agronomy districts of south-west and central NSW. This process (described below) was used to arrive at farmer ‘best management practices’ (BMP) for lucerne establishment and grazing management for the zone.

The process was also used (in a later focus group exercise) to generate ideas and priorities for research on lucerne for the zone as a whole, and in some cases for particular districts.

### Process and workshop format

Initially, farmer contacts in each ‘pastures pay’ group were asked to prepare an invitation list comprised of experienced lucerne growers in their district to form a farmer focus group. Following agreement on a suitable composition for the focus group workshops were held at suitable local venues (farms, halls, hotels).

At the start of workshops the aims were outlined and participants were supplied with paper and pens. Each farmer was asked to write down their ideas on best management practices and then asked to read out one of their points.

### Objectives

To arrive at farmer best practices for lucerne establishment and grazing management in the 350–450 mm cropping zone of southern NSW.

### Tool type

- A process involving farmer participation in focus groups to help define best management practices (BMP) for lucerne in a region and then designing appropriate extension material.

### Extension outcomes

The main outcomes of the farmer focus workshops included:

- The collaborative development by farmers and pasture scientists of a list of best practices for lucerne establishment and grazing management—for use by extension agents and farmers.
- Use of the farmer BMP for lucerne as the basis for several successful field days on lucerne.
- Production of a brochure *Lucerne pays – grower tips for successful dry land lucerne*. The brochure features experienced lucerne growers and their comments, and is widely distributed throughout central and south-west New South Wales.
- A poster on the methodology and outcomes of this participatory process was prepared for the Grasslands Society of NSW Annual Conference, Wagga Wagga, in 1996.
- An informative video film was produced on pastures in low rainfall environments, focusing on lucerne and the BMP of experienced farmers.

Each new point was recorded on a separate piece of card and blue-tacked on a board and the process continued around the group, until all ideas had been recorded (ensuring that each participant had equal opportunity to contribute).

The points raised were then arranged in groups by the participants, under various headings (e.g. establishment, cover crops, insect control, grazing management, weed control) and the groups of ideas were prioritised by participating farmers

The results of this workshop were documented and later redistributed to participating farmers across five districts for further comment. They were then used to develop extension outcomes for the zone.

Later, a second round of focus groups was conducted on research needs for lucerne growing, and those results were presented to research agronomists, who incorporated these into proposals to research funding bodies.

### **Some conclusions**

The above process has been a successful way of involving farmers in providing ideas for developing extension materials on an important topic. The strong participation and local flavour of the messages developed led to strong feeling of ownership and cooperation by the farmers involved and thus is now spreading to other topics in this cropping and grazing region. Both farmers and extension officers enjoyed participating in the workshops, and this assists future extension efforts.



Bernadette York, NSW Agriculture

NSW agronomist Peter Matthews and farmer Carole Leach record dry matter readings from Colinroobie Pastures Pay Group lucerne trials.

## SOME DOS AND DON'TS OF THE FOCUS GROUP BMP PROCESS

- ✓ Use the local district officer or other suitable person as the facilitator. This removes barriers so that the process can flow.
- ✓ Make participants welcome at the workshop.
- ✓ Explain clearly the aim of the workshop, timeframe, sequence of events (process) and expectations.
- ✓ The topic should be highlighted both verbally and in written form so that the participants remain focused on the it.
- ✓ Be sure to draw out all ideas—even those that appear to be trivial—as these may become important after further discussion.
- ✓ Give all ideas equal importance so that participants feel that they have contributed.
- ✓ Provide comfortable surroundings and suitable refreshments for the focus group.
- ✓ Ensure that feedback on results is as rapid as possible.
- ✗ Don't trivialise the value of any participant's ideas even if stated in an unscientific way.
- ✓ Only take one idea at a time from participant so that individuals are not able to dominate the process.
- ✗ Don't embarrass participants by requesting that their written ideas be seen by others.
- ✗ Don't make workshops too serious: enjoyment is important.
- ✗ Don't forget to acknowledge and thank participants for all their contributions.

Mary-Anne Lattimore, NSW Agriculture



Graham Hawker, Lloyd Charles and Bob Leach talk trial results at a meeting of the Colinroobie Pastures Pay Group. Discussions where members share experiences and knowledge, play an important role in the success of the group.

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LMB 21, ORANGE NSW 2580.
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Strategy) Workshop Method, Integra Pty Limited, Perth, WA.

## Further information

Information on the process used and technical aspects can be obtained from:

- . Dr Peter Orchard  
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Agricultural Research Institute  
PMBag, Wagga Wagga, NSW 2650
- . John Whiteley  
NSW Agriculture  
PO BOX 63  
Berry, NSW 2530

## PARTICIPATIVE CATCHMENT PLANNING

**John McLatchey, Clive Knowles-Jackson, Nev Booth**  
**Department of Natural Resources Queensland**

### Introduction

The example of catchment planning used in this tool is for floodplain management. A similar process could also be developed for other issues (e.g. salinity management).

Floodplains are subject to broadscale overland flows that can easily be diverted (unwittingly or otherwise). Since problems arising from such interference can occur a long way from the cause, it is essential that:

- communities become involved in their own catchment management;
- the plan is coordinated; and
- stakeholders gain an understanding of the background to problems and solutions.

This tool is used to develop management plans for the natural resources of floodplains as a whole. The technique was born out of necessity: a previous floodplain planning project met with very little success because the plan was developed *in consultation* with stakeholders. Following this project it became obvious that *true participation* by stakeholders is essential to gain real community acceptance of such plans.

The process has been widely used, and refined progressively, following workshops throughout the Brigalow Floodplain (91 000 ha and 250 landholders), the Jimbour Floodplain (30 000 ha and 80 landholders) and the Upper Condamine Floodplain (450 000 ha and 1500 landholders) on the Darling Downs in Queensland.

### Workshop process

#### Before the workshops

Community members (stakeholders) generally need to be focused on the same issue (i.e. a common enemy) to gain their support for any project. It is strongly suggested that a representative 'project committee' be formed and frequent contact made with constituents (e.g. through personal visits, phone and newsletters) covering subjects such as the project program (including the collection of topographic data and workshops), timeline, milestones to be met, progress made.

### Objectives

To maximise stakeholder/community ownership of natural resource management plans, through increased understanding of ecological factors and strong participation in the planning process.

### Farmer evaluation

- 'Attitudes have changed—we now look at the whole situation, not just our own problem in isolation.'
- 'Our awareness of property management and water coordination increased; it helped us to see a much bigger picture than just soil conservation—the total picture of sustainable agriculture.'
- 'As local authorities, we now have an improved strategic approach to infrastructure development.'

### Tool type

- A six-hour workshop at local venue, using aerial photo-enlargement and maps as a basis for planning. Participants given planning/mapping kit and data to work with in developing collaborative plan.

### Materials

- Area map (satellite imagery or aerial photography) with accurate topographic information, planning kit and technical information for each participant
- Whiteboards, post-it notes, overhead slide projector, slides, screen, landscape model and posters. Some of these are available from:  
 Resource Management, South-West Region,  
 Department of Natural Resources  
 PO 318 Toowoomba, Queensland 4350  
 Telephone: (07) 4688 1000; fax: (07) 4688 1487

Current crises (e.g. during a flood year) can provide an ideal basis for the project to proceed.

#### During the workshops

The goal of the workshops is to identify the issues involved and develop a local area management plan and an action timetable for implementation. This is achieved by facilitating and assisting the participants in their understanding of the factors involved, so that *they* can produce the plan.

It is as well to be aware that perceptions of the 'ideal plan' vary with the beholder. Therefore room must be provided (within technical limits) for each stakeholder to prepare a plan that meets his/her requirements. The reasoning behind the content chosen for the workshops is shown in Table 1.



#### After the workshops

Copies of a report of the workshop outcomes (together with maps) are distributed to stakeholders. These provide a record of the workshop and an implementation strategy for the plan and are called the local area management plan.

Average attendance rates are in the order of 80% but can be as low as 50%.

Some follow-up encouragement with groups is generally important.

**Table 1.** Steps and purpose of activities in the community workshop process.

| Process/Content                                                                                                                                                                                                         | Purpose                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1. Clearly state the purpose of the workshop, our role, their opportunity. Define floodplain management.                                                                                                                | ` <i>Provides focus and gain involvement</i>                                                                                      |
| 2. List issues of concern. Ask all participants to be 'up front' and honest.                                                                                                                                            | ` <i>Gives validity to personal issues and relieves tension</i>                                                                   |
| 3. (a) Use a model landscape to improve skills in reading topographic maps.<br>(b) Use a hypothetical catchment to apply new knowledge, identify problems and develop solutions in a non-threatening group environment. | ` <i>Promotes group learning and improves objective thinking</i>                                                                  |
| 4. Apply learning from the hypothetical exercise to own map. Use template to design run-off strategies.                                                                                                                 | ` <i>Plans for the real world (reflect on new knowledge and apply to participant's own area)</i>                                  |
| 5. Revisit concerns listed at item 2.                                                                                                                                                                                   | ` (a) <i>Participants are able to develop an action strategy to deal with the issues</i><br>` (b) <i>Identifies further needs</i> |

## COMMON PROBLEMS + ADVICE ON USE OF TOOL

- ✓ Emphasise 'group' ability to be heard and the value of coordinated community planning.
- ✓ Emphasise the need for participants to 'make it happen'.
- ✓ Emphasise the importance of local knowledge and ability.
- ✓ Stay focused. A crisis is not always bad; it will help the community to focus on the subject.
- ✓ Limit workshop numbers to 15–20 to maximise participation.
- ✓ Workshops should be composed of contiguous landholders and service providers because coordination is a major goal.
- ✓ Maximise 'communication' between neighbours.
- ✓ A facilitation team of about four is required.
- ✓ *Adapt the process, do not 'transplant' it.*

### Example agenda: participative planning workshop (an intensive half day)

1. Welcome (5 minutes, Community Chairperson)
  - Warm up (5 minutes, whole group)
2. Introduction to workshop (20 minutes)
  - Introduction (5 minutes)
  - Agenda for the day
  - Workshop process (5 minutes) ( \* Item 1 in Table 1)
  - Establish ground rules
3. Property stock take (20 minutes)
  - Individual orientation exercise (10 minutes). Mark property details on overlay for own use.
  - Group activity 4–5 per group (10 minutes). Use overlays to record in green 'where the runoff water goes now' (existing flow paths).
4. Problem area identification: what and where (30 minutes)
  - Ask participants to write down on post-it notes the issues affecting the management of the natural resources on their farm even if the problems start somewhere else in the catchment area. Stress that they should be specific and up front. Stated as 'The problem is ...'
  - Allow about 5 minutes for people to get their thoughts together and write down issues on post-it notes.
  - Participants place a dot (with a number on it) on the big map on the wall to mark the location of the issue; and the post-it note (with same number) attached to the edge of map.

5. Understanding the topographic map (10 minutes)
  - Use a model hill and associated map to demonstrate interpretation of contour lines.
  - Explain the practical uses of topographic maps (e.g. heights, distances, pumping).
6. Hypothetical catchment (50 minutes)
  - Group learning exercise called 'Greater Expectations' (\* Item 3(b) in Table 1):
    - Small groups report back to whole group and discuss the problems and possible solutions. Discussion of farm contribution to water management on the floodplains.
    - All team members should be guiding the participants in interpreting the map and identifying problems.
7. Break (30 minutes)
8. Back to the real world (20 minutes)
  - Group activity (4–5 people per group):
    - Record where the water should go (identify natural flow paths of workshop area) in blue on an overlay (application of learning from session 6).
9. Benefits of water management (20 minutes, technical presentation)
  - This could include a presentation (e.g. 'Runoff water is a resource to be managed'). Include a series of slides issues.
10. Develop an action strategy (40 minutes) (\* Items 4 & 5 of Table 1)
  - The overlays with green lines (where water goes now) and the blue lines (where the water should go) are located together over satellite imagery and used as a base for discussion.
11. Wind-down exercise (5 minutes)
  - Measuring areas with dot grids.
12. Where to from here? (10 minutes, Community Chairperson)
  - What we are expecting participants to do?
  - When will the outcomes of the workshop be distributed?
  - What the participants can do now?
13. Close.

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**Further information**

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## CAPTURING COMMUNITY UNDERSTANDING OF NRM

Lisa A. Lobry de Bruyn

### Introduction

Approaches to solving environmental problems rely increasingly on asking local communities to solve their own environmental problems, often with minimal government support and little training in how best to proceed. The process outlined here could be used with community groups to identify and resolve a variety of natural resource management issues, such as native vegetation management or water reform. I will demonstrate this process by drawing on insights experienced while conducting a Grains Research and Development Corporation (GRDC) project on farmers' understanding of soil health.

### The Soil Health Case Study

The Soil Health Case Study set out to develop, with farmers, a checklist of soil health characteristics that they could use and adapt to monitor the condition of their soils. Information collected ranged from technical (soil testing) data to farmers' views of the same soils. The first step was to conduct interviews, then farm visits and soil testing, followed by workshops.

In capturing farmer's perceptions, the concept of data triangulation—in which different techniques are used to achieve cross-checking of information and an appreciation of variability—was adopted. Data gathering techniques with people involved:

- in-depth face to face interviews with concerned parties by an experienced interviewer.
- follow-up informal meetings (if necessary) with participants with another person, where notes were taken and additional data collected
- photographs (if necessary) of subject material, as chosen by participants, to record a visual memory of their choice(s) as well as to observe from another vantage point, their understanding of the issues.
- workshop to discuss preliminary findings, after initial analysis and interpretation by the researcher, with participants in small groups (4–5 people) in participants' local town centre.

### Objectives and outcomes

To capture landholders' intuitive understanding and knowledge of a local natural resource issue.

To design a process that incorporates local community knowledge, to assist communities in resolving natural resource issues.

### Tool Type

- Combination of individual activity, focus group discussion in a facilitated workshop and field (sampling) activities.

### Materials

- Agendas for each person as well as an enlarged copy for the wall
- Suitable venue on neutral territory, with access to rooms with moveable tables and comfortable seating for two small working groups (5 people)
- Overhead projector and screen, power source, and other visual aids, as well as extras for 'give aways'
- Continual tea/coffee and biscuits and light lunch
- Pencils, sharpeners, rubbers, blue tak and paper, tape recorder or laptop computer or notebook, camera to take photographs of proceedings and group photograph

## Steps in the Soil Health Case Study process

### Materials and steps for soil sampling (if applicable)

1. Prepare itinerary, map and directions to participants' locations.
2. Allocate time to meet each participant, and involve them in sampling.
3. Stakes to mark sampling survey transect. Soil sampling equipment (e.g. spade, auger, buckets, plastic bags, water proof marking pens, labels—for inside and outside the bag, elastic bands, camera, signs for photographs showing farm number, date and paddock type, soil sampling description sheets and site description sheets, pencils, sharpener and rubber, mallet, compass, tape measure (100m), clinometer, camera and film).

### Process for soil testing at each farm

Farmers were asked to locate what they believed to be a healthy soil, based on the features they had discussed in their interview. The rationale for phrasing the question this way is to avoid leading the farmer, or choosing a paddock to satisfy 'my requirements'. Often farmers respond by saying 'What do you want?', and I would repeat that the selection of the 'healthy soil' paddock was their choice, and based on their understanding of soil health, and not guide their selection by saying 'What is your best performing paddock?' or words to that effect. We would discuss their decision-making process. I asked them about the land management history of the paddock. The farmers also located for me to sample, a site where the soil had not been cultivated, on the same soil type (referred to as the 'control soil'). The purpose of the control soil was to act as a reference point for the 'good' soil, and to help determine if soil condition had changed since farming. Sometimes this meant choosing an area that may have been grazed.

Through the development of a checklist we hope to empower landholders to collect their own data and build trend lines for their own paddocks, to enable them to make informed decisions on soil condition and how their management practices are impinging on soil health. I took field notes of our conversation, after the farmer had left, and these will be added to their

interview data. Some farmers stayed with me, and helped in soil profile sampling and description.

### **Workshop process**

The purpose of the workshops were to:

- verify that interpretation of farmer interview transcripts accurately reflected their understanding of soil health
- give farmers opportunity to add, amend and validate checklists of soil health identification and measures, especially on the terms to distinguish between healthy and unhealthy soil
- present farmers with soil/agronomic brochures and information sheets



Farmers examining agronomic and soil information and making notes on their views.

produced by scientists, and ask them to criticise these in terms of their clarity, presentation and relevance. In addition, to relate the outcomes to how best to package such information for the soil health checklist, and to disseminate so it does not 'sit on the shelf collecting dust'.

- view the soil testing findings and a district profile on soil health, and examine the role of soil testing in monitoring land condition
- obtain farmers' opinions on the need for a soil health checklist and whether they think it would help them to monitor land management practices and changes in soil health

Soil health workshops were conducted in groups of 4 or 5 people.

#### Workshop facilitation

At the start of a workshop it is important to emphasise ground rules for group discussion (e.g. all participate, focus on question, no-one to dominate and no silly suggestions). Most groups were excellent at self-regulating their involvement in group discussions and needed little reminding of the ground rules.

My involvement in group discussions was to keep the group on task and to time. Individuals examined and evaluated the soil information packages from other sources. These were numbered and passed around the group. They quickly perused each package and noted down their overall thoughts. We later held up each package and asked each farmer in turn what their overall feelings were on the package:

- Had they seen it before?
- Did they have one?
- Would they use it?
- What did they like about it?

This process usually took an hour and a half rather than the hour allotted and involved 10–15 different information packages.

Lunch was invariably delayed, but achieving the majority of the agenda before lunch meant that the post-lunch sessions were more relaxed.

#### **ENSURE THAT YOU:**

- ✓ Clearly acknowledge the contributions of participants.
- ✓ Provide a sense of 'where to from here'.
- ✓ Send out deliberations from the workshops to participants and non-attendants (who had requested the information) within 2 months of the final workshop.
- ✓ Follow-up avenues are important to ensure the process is ethical and participative, and not tokenistic.

#### **Further reference materials**

- Lobry de Bruyn L.A. 1999. Farmers' Perspective on Soil Health: Capturing and Adapting Intuitive Understanding of Soil Health to Monitor Land Condition. Presented and published in proceedings of 'Country Matters' 20–21 May Canberra 1999. On web at: <http://www.brs.gov.au/events/country/proceedings/index.html>
- Lobry de Bruyn L.A. and J. A. Abbey 1999. Talking Dirt: A Qualitative Study of Farmers' Soil Sense. Presented and published in proceedings of AQR 'Rigour in Qualitative Research', 5–9 July Melbourne 1999. On web at: <http://www.latrobe.edu.au/www/aqr/>

## Workshop Agenda

9.45 Introductions and morning tea

10.00 Outline the development of soil health checklist.

- Describe your district's profile: demographics and soil health.
- Describe the methods used in your district to measure soil characteristics.

10.30 Assessment of other soil kits and discussion on presentation of soil health checklist

- What is useful/not useful about these kits?
- What form should it take?

11.45 Group discussion on identifying healthy and unhealthy soils

- Discussion of list of characteristics derived from interviews on healthy and unhealthy soils.
- What characteristics are missing? What details can be added to the list?
- How would you describe those missing characteristics for healthy and unhealthy soils?

12.30 Setting priorities: ease of recognition and inclusion of characteristics in checklist.

- Are the characteristics discussed easy to recognise?
- Are they important? If so, why.

### Lunch break

1.30 Group discussion on measuring the characteristics of healthy and unhealthy soils

- Are any techniques for measuring soil health missing?
- Can any detail on techniques be added? (e.g. when and how often should the characteristic be appraised?)

2.15 Setting priorities: group discussion on measuring the health characteristics of soils

- Which techniques do you use?
- Which techniques are useful and need to be included in a monitoring kit?
- Which techniques are easy to use?

2.30 Summing up and final issues.

- Further feedback on soil data.
- Sending out the final product.

## 500 FARM PLANS LATER: A GROUP FARM PLANNING PROCESS

**John Petheram, Robert Binns**

**Institute of Land and Food Resources, University of Melbourne, Creswick & Longerenong Campuses**

### Introduction

Farm planning, whole farm planning, and property planning are terms used to denote a process (of land use planning) in which natural properties (and hazards of use) of a farm are assessed, and then farm enterprises are designed to match the land's potential and limitations on different parts of the farm, as well as current markets and best farming practices. Farm planning was traditionally done on a one-to-one basis for individual farmers (Junor 1987), but group farm planning has many benefits and the process described here is only one example of many programs in various states.

Group whole farm planning in Victoria evolved from concepts developed in the Potter Farmland Plan in south-west Victoria, in which the collective knowledge of farmers and specialists were combined to assist participants to develop plans of their properties to take into account needs for land improvement as well as greater efficiency and farm profitability. An accredited training course in WFP was developed in 1993 by the Victorian College of Agriculture & Horticulture. Farmer groups in grazing areas were attracted to WFP because of the obvious advantages for grazing management, stock movement and tree establishment. Later, the process was developed for cropping areas, with greater emphasis on topics requested by farmers in those areas—particularly soils, tillage, crop rotations and weed control (Petheram and Binns 1993, Binns and Petheram 1998).

Participants pay a fee for Group WFP, although there are subsidies for official WFP courses or for aerial photography associated with the process. In some States a similar process is available through the national Property Management Planning, FarmSmart or other State and nationally-funded programs.

### Objectives

To enable participants to develop plans for the development of their own properties, that are suited to the land's potential, in line with best viable practice, and address landcare issues on and off the farm.

### Other learning outcomes

- Participants, facilitator and visiting specialists gain local knowledge on soil and land use from experienced farmers
- Land-use and land degradation issues important to the community are discussed in a way that can lead on to joint planning and sound community action
- Group cohesion and learning enhanced

### Tool type

- Group whole farm planning (WFP) is run as a series of seven or eight sessions, designed by the participants to cover learning activities related to important soil, land and business issues in the area. Air photos of farms are used as the basis for mapping natural resources and then for showing physical aspects of the plan. At the last session, participants present their farm plans and receive feedback from the group and visiting specialists. The Group WFP process can be run as part of an accredited tertiary course.

### Materials

- Participants require a suitable aerial photo enlargement of their property
- The cost of the program usually covers two transparent overlays, a set of marker pens & a farm plan file
- Workshops are usually held at local halls and on farms

### The group whole farm planning process

Once a group of (10–20) farmers decide to go ahead with WFP, a session is held to explain the course process and to design the series of workshops with the group. A list of typical workshop topics is suggested and farmers are asked to add other topics needed in their area. Participants then score the various topics, to allow the facilitator to prioritise topics and plan the seven or eight workshop sessions (see Box 1). Participants are also asked for ideas on suitable specialists to be involved in particular workshops.

The example of average scores and topic ranking shown in Box 2 is for a group in a cropping area with soils structural degradation problems. The rankings of topics is used to plan a series of workshops, visits and activities over a one-year period, as shown in the example program in Box 3.

Although the detail of course and workshop content varies from group to group, some core topics are included in each series (marked \* in Box 1), because information and skills from these have been found to be fundamental to the farm planning process. Nevertheless, input into the design of the workshop series gives participants ownership and commitment to the program. Participants are encouraged to involve family members including children in the workshops and WFP process. Evaluation has shown that many participants have found the WFP process to be an extremely valuable and even moving experience. Some WFP groups have gone on to form Landcare (or other) permanent groups which periodically review the progress of their farm plans and also tackle important community planning issues.

**Table 1.** Prioritising ideas for change and action on the farm. (Scores: 1=low, 2=medium, 3=high, 4=very high)

| Proposed changes to farm or management | Approx. cost \$ | Return/unit cost<br>Score & weighting (eg. 4) | Benefit to land/soil<br>Score (4) | Living environment<br>Score (3) | Land value<br>Score (2) | Labour efficiency<br>Score (4) | Long term productivity<br>Score (3) | Total score<br>Cost |
|----------------------------------------|-----------------|-----------------------------------------------|-----------------------------------|---------------------------------|-------------------------|--------------------------------|-------------------------------------|---------------------|
| e.g. Purchase direct drill             | 8000            | Score 4<br>(4x4 = 16)                         | 4<br>(16)                         | 0<br>(0)                        | 2<br>(4)                | 3<br>(12)                      | 3<br>(9)                            | (57)                |
| Fence swamp                            | 3000            | Score = 1<br>(4x1 = 4)                        |                                   |                                 |                         |                                |                                     |                     |
| Apply gypsum to China paddock          |                 |                                               |                                   |                                 |                         |                                |                                     |                     |

After assigning scores (1–4) for each proposed change, farmers can apply weights (e.g. x 2, x 3 or x 4) to each column according to their values and farm goals, before adding row scores to obtain a total score. The total scores are used to assist in placing priorities for action on each item in implementing the farm plan.

**Box 1. GROUP WHOLE FARM PLANNING – DESIGN OF PROGRAM**

1. A list of standard topics that can be included in the WFP workshops is presented.
2. Participants suggest additional items, and these are added to the list, after discussion.
3. Participants are asked to score each of the items on the full list—for importance to their needs in farms planning and on this course.

**TYPICAL TOPICS**

Importance score

|                                                   | Importance score |   |   |   |      | Av    | Topic |
|---------------------------------------------------|------------------|---|---|---|------|-------|-------|
|                                                   | Low              |   |   |   | High | Score | rank  |
| * Aerial photography use and scales               | 1                | 2 | 3 | 4 | 5    | 3.4   | 7     |
| * Mapping soils and land classes                  | 1                | 2 | 3 | 4 | 5    | 4.2   | 1     |
| * Defining the aims for the farm                  | 1                | 2 | 3 | 4 | 5    | 3.4   | 7     |
| * Land degradation and reclamation issues         | 1                | 2 | 3 | 4 | 5    | 4.0   | 2     |
| Farm financial planning                           | 1                | 2 | 3 | 4 | 5    | 3.9   | 3     |
| Farm trees/farm forestry (environ. & profit)      | 1                | 2 | 3 | 4 | 5    | 3.3   | 8     |
| Water distribution on the farm (stock & domestic) | 1                | 2 | 3 | 4 | 5    | 3.2   | 10    |
| Conservation tillage concepts and practices       | 1                | 2 | 3 | 4 | 5    | 3.3   | 8     |
| Precision farming                                 | 1                | 2 | 3 | 4 | 5    | 2.8   | 11    |
| Crop selection, management and rotations          | 1                | 2 | 3 | 4 | 5    | 2.6   | 13    |
| Pasture & grazing management                      | 1                | 2 | 3 | 4 | 5    | 3.8   | 5     |
| Salinity Management                               | 1                | 2 | 3 | 4 | 5    | 2.0   | 16    |
| * Ideal farm layout                               | 1                | 2 | 3 | 4 | 5    | 1.6   | 19    |
| Community land use issues                         | 1                | 2 | 3 | 4 | 5    | 1.8   | 17    |
| Fire prevention planning                          | 1                | 2 | 3 | 4 | 5    | 1.2   | 21    |
| Farm wildlife (biodiversity on the farm)          | 1                | 2 | 3 | 4 | 5    | 1.6   | 19    |
| <b>Additional topics from participants</b>        |                  |   |   |   |      |       |       |
| Commodity marketing                               | 1                | 2 | 3 | 4 | 5    | 2.3   | 14    |
| Weed control—summer, crop and fences              | 1                | 2 | 3 | 4 | 5    | 3.9   | 3     |
| GMO's                                             | 1                | 2 | 3 | 4 | 5    | 2.0   | 16    |
| Succession Planning                               | 1                | 2 | 3 | 4 | 5    | 2.7   | 12    |
| Business planning                                 | 1                | 2 | 3 | 4 | 5    | 2.3   | 14    |
| Diversification/Alternative enterprises           | 1                | 2 | 3 | 4 | 5    | 3.6   | 6     |

**Box 2.**

Example of results of Gp. prioritisation of program topics

At each workshop, the participants learn and practise skills needed in developing their farm plans. This starts with skills in mapping and use of air photography, followed by soil and land classification and definition of farm family goals. Between the sessions the farmers map their land types, define their goals for their properties, and then show the results informally at the next session. At the second last workshop, participants are shown a decision matrix for use in prioritising their plans for action in implementing their WFP (see Table 1). An outline of the structure of a Whole Farm Plan is shown in Box 4.

**Box 3.** Example program for group whole farm planning.

- Day 1.      Aims of property planning  
              Specification and ordering of aerial photography for each farm  
              Introduction to land capability classification
- Day 2.      Group prioritisation of topics for course  
              Discussion of program, venue and timing  
              Aerial photography: scales and interpretation  
              Group discussion of local main land types
- Day 3.      Soil characteristics and texturing exercise  
              Field visits to main land types (soil skills)  
              For each main land type: definition of environmental risks  
              Recommended management practices
- Day 4.      Farmer progress with mapping main land classes on farms  
              Specialist session on main land degradation topics:  
              e.g. soil structural decline; symptoms, processes, remedies  
              Stock and access considerations
- Day 5.      Farmer progress with scales, mapping and measurements  
              Setting goals in farming; environmental, financial and lifestyle  
              Climate and drought (risk) planning, alternative farm enterprises
- Day 6.      Conservation farming practices, tillage and stubble  
              Crop and pasture rotations  
              Preparing the ideal property plan
- Day 7.      Farmer progress with property plans  
              Trees on farms: roles, species, methods  
              Prioritising ideas for change on the farm (decision matrix)
- Day 8.      Farmer presentations of property plans to the group  
              Final barbecue. Evaluation forms in stamped envelope

**Box 4.** Summary structure of a whole farm plan.

I. MAPS

OVERLAY 1 - NATURAL & PERMANENT FEATURES -  
NATURAL RESOURCES  
LAND / SOIL CLASSES  
PERMANENT FEATURES

OVERLAY 2 - PROPOSED LAYOUT  
FENCES (TO LAND CLASS)  
SHELTERBELTS, WOODLOTS  
LANEWAYS  
WATER SUPPLY

II. THE FARM PLAN FILE

A. AIMS OF THE FARM (BUSINESS)

B. SUMMARY DESCRIPTION OF EACH LAND CLASS

- Land and soil type description
- Main limitation and advantages
- Appropriate management practices

C. TABLE SHOWING DESCRIPTION, AREA AND PERCENTAGE  
OF FARM FOR EACH LAND CLASS

D. SUMMARY OF POTENTIAL AND EXISTING LAND/SOIL  
PROBLEM ON THE FARM

E. LIST OF STRATEGIES FOR CHANGE

- Layout changes
- Management practices

F. PRIORITIES FOR CHANGE & ACTION ON THE FARM

- Prioritising ideas for change in the farm plan
- Ranked list of the ideas for change
- Financing the farm plan

G. RISK MANAGEMENT STRATEGY

- Drought strategy

H. OTHER INFORMATION CONSIDERED IMPORTANT

- Rainfall and other climatic records
- Paddock records
- Crop records
- Fertiliser records
- Stock records
- Animal health
- Pasture condition

I. SOURCES OF RELEVANT INFORMATION/USEFUL WEB SITES ETC.

## References

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## SOIL CHECK

**Daya Patabendige**  
**Agriculture Western Australia**

### Introduction

A better understanding of soils and how soil properties affect crop yields were highlighted by a needs analysis survey of growers in TopCrop groups in Western Australia. Subsequently, TopCrop West applied for a grant from NLP to develop the Soil Check training module, the soil check kit and to deliver soils field days to grower groups.

### The workshop process

The workshops are offered to grower groups through the TopCrop newsletter 'Topline'. Interested groups then organise the workshop and field day in consultation with the TopCrop provider (Agency Development Officer, Company Agronomist or Consultant) and the Soil Check Project Officer.

The group coordinator or the provider usually contacts the Soils Project Officer who will provide a list of topics out of which the group will select topics of interest, which will be covered in greater detail in activities at the workshop. The most important soil properties are always covered at the workshop.

### Preparation for workshops

The Soils Project Officer contacts the Agency Development Officer in the District and discusses with them the soil problems in the area, the major soil types, and what outcomes the growers in the group want. If the soils in a particular region are not familiar to them, they will contact the Soil Resource Officer in the region and Agency agronomists to gather local information.

The TopCrop provider for the group is then asked to construct soil pits to cover the major soil types—good and poor.

### Objective

To enable farmers to gain a better understanding of soils in their area and implications for crop production and land management.

### Other learning outcomes

- Better understanding of soil properties and how they affect production potential, limitations to crop growth and crop and variety selection to suit soil type.

### Type of tool

- Two half-day or one-day workshops (depending on grower interest) in the field and indoors involving groups of farmers. Soil Check is designed to be done as 2 half-day workshops, one in summer or autumn as pre-season soil check and the other in winter or spring as the in-season soil check. However, both can be done as a one-day workshop if soil pits can be dug in the summer.

### Materials needed

- Soil Check Kit (from Land Management Society Inc.)
- Properly constructed soil pits at each of 3–4 sites, usually along the slope covering several soil types, with clean face, facing sun and sloping ramp on other side, for easy access to the pit face by farmers (see Figure 1)
- Soil augers

### Contents of (LMS) Soil Check Kit

- Soil texturing card—guide for hand texturing by growers
- Soil structure test card—to test the structural stability of soils
- Soil group charts—to identify and map soils and lines for crop selection
- Soil pH test kit—to test the pH of soils
- Soil probe with handle and extension rod—to detect restrictions to root growth
- Water repellency test kit—to test the degree of non-wetting in soils
- Infiltration ring or cylinder—to test infiltration rates
- Soil sampler—for taking samples for soil fertility testing (optional)
- Clip board, notes and information leaflets

If the group has dug more than 4–5 pits, the Project Officer usually examines these before the workshop and notes which will be useful at the workshops.

Overheads are modified to suit the needs of the group beforehand, if needed.

Organisation of the venue and the logistics of running the workshop are the responsibility of the TopCrop provider or the group leader.

#### Running Soil Check workshop

- . Growers meet at a convenient location such as a community hall or a shearing shed
- . The structure of the workshops is flexible. If the growers want to discuss only soil issues, there is only one indoor session. If they want to discuss plant nutrition and how to interpret soil fertility test results as well, two indoor sessions are held.
- . The first indoor session usually covers soil properties that affect plant growth and production potential. The properties discussed are those which affect water infiltration (water repellency, soil texture, structural stability—slaking and/or dispersion leading to hardsetting, crust formation or surface sealing, clay mineralogy—shrink/swell clays, etc), water transmission within the profile, water holding capacity, nutrient retention ability and properties that affect root growth, pH, electrical conductivity, nutrient deficiencies, and toxicities.
- . In this session the participants learn why they need to do the different tests or checks in the Soil Check recording sheet. The soil structure stability test is also demonstrated and used in this session with a slaking soil and a dispersing soil, brought in by the Project Officer.
- . Informality is important, to encourage questions and active discussion of various problems on participants' properties and how they are trying to manage them. A whiteboard comes in very handy in these discussions.
- . The indoor session usually lasts for 45 to 60 minutes. The field session starts immediately or after a short coffee break.

The field session is held at each soil pit. The Soil Check kit is used in a group learning activity to enable growers to examine the soil properties that are important to the growth and yield of crops. The Soil Check kit comes with instructions for use of the kit (see Figure 1 for an example of a field recording sheet used by farmers from the kit).

Although the workshops can be held at any time of the year, growers are encouraged to check the soils in their own paddocks at two different times of the year—summer and winter. In the summer, properties of the soil surface and the first 20 cm are checked, including the sampling of soil for testing for nutrient levels. In the winter, when it is easier to dig, properties of the soil profile are examined (refer to *TopCrop Monitoring Guide*).

After the workshops the growers are expected to check the soils in their own paddocks and record the results in the Soil Check recording sheets shown here or in TopCrop recording cards such as Cereal Check, Pulse Check, Canola Check or the generic Crop Monitor

The participants undertake the following tests on the selected soils and locations (and soil pits), using components of the Soil Check kit, after each test has been demonstrated by the facilitator. The results from each site are entered by participants in a 'Soil Check' record sheet.

#### **Pre-season soil check (December to March in southern Australia)**

**Surface condition.** This first check is best done in summer, when the soil is dry. The tests are for hardsetting, surface crusting, surface sealing, cracking and water repellence. No soil pits are required for these tests, some of which are described here.

**Hardsetting.** If the soil is hardsetting, a pencil can not be pushed into the soil. The participants use a pencil or a stick or the soil probe in the kit.

**Cracking.** Cracking soils have clay minerals that swell when wet and shrink when dry. When wet these soils swell and close all the cracks and pores, drastically reducing further water infiltration. If cracks when completely dry are greater than 10 mm, it is a cracking clay soil.

**Water repellence.** The participants use the LMS Water Repellency Test Kit to test whether the surface soil is water repellent or not, and if there is a problem, determine the degree of repellence using the four numbered solutions. The test should be repeated in at least four places. Solution/level number 4 represents a very severe water repellency problem. This test is carried out only when the soil is very dry in the summer, and in the morning when the soil not too hot (<25°C). The growers do this test by scraping off the first 3–5 mm of soil and organic debris and placing a drop of test solution on the surface which would remain on the surface as a bead for more than 10 seconds if the soil is non-wetting.

**Top soil texture.** The soil texture card with its step by step instructions, is consulted by participants in 'hand-texturing' the soil. Representative samples of soil are taken from the entire depth of the layer to be textured—in this case the A horizon. The growers follow the instructions to make a ball and then ribbon out as shown, to determine the correct texture from the scale on the texture card.

Sub-soil textures are usually determined in winter during winter soil check. However, if a soil pit is available, different soil horizons are marked and each horizon is textured separately.

**Soil structure test.** The soil structure test card with stepwise instructions and photos is used to test the stability of the soil structure. The growers do this test by using the small jars provided and distilled water. They may also use empty jam jars or drinking glasses and rain water

**Soil pH.** The soil pH test kit is utilised to test for pH, by following the instructions. The soil sampling auger (or a spade) is used to take representative samples from 20 sites in a paddock, from depths 0–10 cm (top soil) and 10–20 cm (sub-surface soil) into separate clean buckets. Mix the soil in each bucket thoroughly and take only 10 g from each bulk sample for tests. The participants are asked to calibrate the pH meter with both buffers before testing the samples.

**Soil sampling for soil fertility tests.** The soil sampling auger (pogo stick sampler) is used to take soil samples from the first 10 cm of topsoil. This is

done by joining the two parts together, fixing a polythene bag to the top hole, pressing the auger into the soil by placing a foot on the peddle and carefully tilting the auger upside down to transfer the soil sample into the polythene bag. Usually 20 cores are taken at random to represent the area. Growers are asked to follow the instructions of their soil test company.

#### **Winter, or in-season soil check**

Soil profile properties are checked in winter when the soil is wet and easier to dig. Growers check the soil profile on the side of a soil pit to see whether there are any restrictions to root growth or water transmission through the soil. Texturing the soil horizons will give an indication of the ability of the soil to retain water and nutrients (e.g. sandy and gravelly soils retain less water and nutrients than loams or clays).

**Barriers to root growth.** The soil probe is used to check for barriers in the soil profile, across a paddock. In light textured soils a traffic pan can develop which can restrict root growth. In loamy to clayey soils a plough pan can develop usually around 15 cm. These pans can be detected by pushing the soil probe into the soil when the soil is wet. If there is a pan you will encounter a zone of resistance to probing. Once the tip of the probe passes through this zone, there will be less resistance. The growers are asked to probe in several places to confirm the existence of the pan at the same depth. The probe can also be used to detect the depth to the clay layer in duplex soils and the depth to any other restriction such as a red-brown hard pan, a calcrete pan, a coffee rock or a cemented gravel layer or shallow bedrock. The groove near the tip can be used to bring up a small sample of soil from the depth of probing by twisting the probe and pulling it up. This is useful in detecting the nature of the clay layer in duplex soils, such as the texture, consistence and sodicity.

If a soil pit is available the growers are shown how to examine the soil profile for compacted layers and other restrictions to root growth and water movement.

**Infiltration rate.** The infiltration ring (cylinder) is used to determine how fast water enters the soil. This is best done after a good soaking rain. However if it has not rained, the soil is wetted beforehand. Growers are shown how this test is done by pushing the cylinder into the soil to a depth of 4–5 cm and filling it with rain water. If a cylinder is not available, growers can use a large coffee tin with the bottom cut out. After filling it with water the time it takes for 100 mm or any set depth of water to soak into the soil or the depth of water entering the soil for a set time is noted down. Then the infiltration rate in millimetres per hour is calculated.

#### **Example**

The time taken for 100 mm of water to enter soil = 37 min and 30 sec.

Therefore the infiltration rate =  $100/37.5 \times 60 = 160$  mm per hour.

The growers carry out the test and calculate the infiltration rate.

**Soil profile.** Digging a soil pit with a shovel or a backhoe or a front end loader to a depth of 80–100 cm and examining it allows proper examination of the soil profile, and the classification of the soil type using the soil key in the soil group chart

## Pre-season CHECK I continued

### SOIL CHECK

(Refer Monitoring Manual section I-6)

#### Landscape position

Indicate the position of soil test sites i.e. A, B, C in the boxes.

*If you wish write down the area in each position.*

#### Soil surface condition in summer

Is the surface hardsetting?

YES / NO (circle)

Is the surface soil non-wetting?

YES / NO (circle)

Are there surface cracks > 10 mm wide?

YES / NO (circle)

#### Soil structure test

(tick)

Slakes

Disperses

Slakes and disperses

Stable

**Top soil properties** (check yourself or send copy of soil test results)

Top soil texture: \_\_\_\_\_ gravel %:

Soil colour (moist): \_\_\_\_\_ pH (CaCl<sub>2</sub>):

**Soil test results.** Company: \_\_\_\_\_ Yr & date of test:

Organic Carbon \_\_\_\_\_ %

Total Nitrogen \_\_\_\_\_ %

Nitrate + Ammonium N \_\_\_\_\_ ppm N status: \_\_\_\_\_  
kg/ha (from N Calculator)

Phosphorus: \_\_\_\_\_ ppm P status: \_\_\_\_\_

Reactive Iron: \_\_\_\_\_ ppm or PRI \_\_\_\_\_

Potassium: \_\_\_\_\_ ppm

Sulphur: \_\_\_\_\_ ppm

EC(salt): \_\_\_\_\_ dS/m

Other nutrients: \_\_\_\_\_

10–20 cm soil sample (for soil acidity): Sub-surface pH (CaCl<sub>2</sub>): \_\_\_\_\_

### Winter soil check

#### Barriers to root growth or water movement

Depth to any restricting layer (within 80 cm), if present: \_\_\_\_\_ cm

Use a soil probe across paddock. (See the notes on the opposite page.)

If present, type of restricting layer (circle from list) and depth:

Cultivation pan / traffic pan at \_\_\_\_\_ cm.

Dense clay layer (in duplex soils) at \_\_\_\_\_ cm.

Cemented gravel layer / coffee rock at \_\_\_\_\_ cm.

Any other hard pan / bed rock at \_\_\_\_\_ cm.

\* Was there run-off from the site? No / Yes \_\_\_\_\_ (month/s)

\* If waterlogging occurs, record in crop stress log (page 21).

If there is more than one pit available, growers are encouraged to examine the soil for any changes of soil colour, texture, structure, gravel content, mottles, presence of lime, and so on. They are then asked to mark out the different horizons and measure the depth of each horizon from the surface (e.g. 0–12 cm, 12–29 cm, 29–85 cm, 85 + cm). The participants note the colour, texture, structure and the pH of each horizon in the blank soil profile diagram in the soil check recording sheet. This will enable the growers to classify the soil by working through the key in the soil group chart. They will also be able to assess the production potential of the soil, whether there are any limitations and whether these limitations to production can be corrected.

## **References**

TopCrop West Monitoring Guide

## **Further information**

- . Daya Patabendige  
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Telephone: (08) 9690 2174, fax: (08) 9622 1902

The kit is available for sale for \$345 from :

- . TopCrop West, Agriculture Western Australia,  
Centre for Cropping Systems, Northam Western Australia 6401 or  
Rural Connect, GRDC

## UNDERSTANDING SOIL WATER

David Freebairn, Steve F. Glanville, G. H. Wokner  
Queensland Department of Natural Resources

### Example of use and process

Welcome and introduction. Usually a 'rope trick' is used to break the ice and also to gauge the interest and experience within the group. Participants line up along a rope, the distance from either end indicating their agreement or disagreement with various questions/practices (e.g. how long have I been using zero-till farming?).

Various topics/questions are then introduced with overhead transparencies and the use of 'icons/tools' from the 'toolkit of toys'. Examples of topics and 'tools' are shown in Tables 1 and 2. Each tool has an exercise and worksheets for use by farmers (see below). Farmers participate in each topic by using the 'toys' and then making calculations. Farmers use data provided (Table 3), combined with data for their own soils, crops and situation.

### Timing

These sessions are best held during the cropping season.

The program on *Understanding soil water* can be covered in one day, or split into 2 or 3 sessions—say over a 2–3 week period.

### Objective

Enable participants to assess their soil water and determine how to use cropping options to make best use of this water.

### Other learning outcomes

- Producers become acquainted with principles of some physical and chemical processes occurring in their soils through interactive activities in the workshop.

### Tool type

- Workshop, using various materials and participatory exercises

### Materials

- 'Toolkit of toys' (sponges, bottles etc)
- Participants notes and worked examples
- Calculators
- Overhead transparencies on research data, district rainfall records, HOWWET program, HOWOFTEN program



Using the rainfall simulator.

**Table 1.** Some questions iconic tools and activities on water in soils.

| Questions                                                                                                                                                                                                                                                                                                                   | Examples of Icons/toys and farmer activities                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Fallow management & water storage principles                                                                                                                                                                                                                                                                                | Sandbox, sponges glass profiles, rain gauge, OHT local rainfall data |
| How is water stored in soil?                                                                                                                                                                                                                                                                                                |                                                                      |
| <ul style="list-style-type: none"> <li>· discuss runoff, infiltration, crop use, drainage</li> <li>· available water and things affecting it</li> </ul>                                                                                                                                                                     |                                                                      |
| How fallows work                                                                                                                                                                                                                                                                                                            | Rainfall simulator demo. OHT, simulator cracking                     |
| <ul style="list-style-type: none"> <li>· stubble effects on infiltration, erosion, evaporation</li> <li>· keeping soil rough</li> <li>· are cracks bad or good</li> <li>· how much water is stored in the fallow</li> </ul>                                                                                                 | soil calculate, use rainfall data                                    |
| How much have you been producing from each mm rain? Worksheets                                                                                                                                                                                                                                                              |                                                                      |
| <ul style="list-style-type: none"> <li>· calculate grain produced per mm of available water on your farm</li> </ul>                                                                                                                                                                                                         |                                                                      |
| How much water have you got this year, and what's it worth? HOWWET computer program                                                                                                                                                                                                                                         |                                                                      |
| <ul style="list-style-type: none"> <li>· how much water can plants get from your soil?</li> <li>· how much rain can you expect while this crop growing? HOWOFTEN computer program</li> <li>· What yields can you expect based on water calculated?</li> <li>· What gross margins can you expect for this season?</li> </ul> |                                                                      |

**Table 2.** List of the iconic tools and uses.

| Topic area                     | Iconic tools and toys                                                                                          |
|--------------------------------|----------------------------------------------------------------------------------------------------------------|
| Plant available moisture       | Sandbox or raingauge, push-probes                                                                              |
| Soil type                      | Sponges of various qualities, water in wash-bottles. Soil pits are used in outside locations where appropriate |
| Protecting the soil surface    | Rainfall simulator (outside), sand columns + muddy water (inside), photo standards (stubble cover) booklets    |
| Soil cracking                  | Sponge foam crack model                                                                                        |
| Water use efficiency           | Grain bags (5kg & 10kg), worksheets, calculators                                                               |
| Climate variability & rainfall | Qld rainfall history (Wilcocks and Young 1991). Computers, HOWOFTEN, RAINMAN, Farmfax service if available.    |
| Soil moisture storage          | HOWWET program, soft-drink bottle demonstration                                                                |
| Evaporation                    | Cylinder representing rainfall, run-off, evaporation                                                           |

**Table 3.** Examples of data provided to participants.**Water available to plants when typical Darling Downs soils are fully wet**

| Soil type                         | Water available to plants when soil fully wet (mm of water/cm of wet soil) |
|-----------------------------------|----------------------------------------------------------------------------|
| Heavy alluvial (e.g. Anchorfield) | 1.9 (i.e. 190 mm/m)                                                        |
| Light alluvial (e.g. Waco)        | 1.7 (i.e. 170 mm/m)                                                        |
| Brigalo clay                      | 1.6 (i.e. 160 mm/m)                                                        |
| Light box clay                    | 1.5 (i.e. 150 mm/m)                                                        |
| Softwood Brigalo                  | 1.4 (i.e. 140 mm/m)                                                        |
| Red brown and red earths          | 1.1 (i.e. 110 mm/m)                                                        |

**Crop Water use efficiency (kg yield /mm/ha)**

|               | Range             | Good crops | Your crops |
|---------------|-------------------|------------|------------|
| <b>Winter</b> |                   |            |            |
| - wheat       | 5–20              | 10–12      |            |
| - barley      | 5–20              | 10–12      |            |
| - chickpeas   | 3–10              | 6–7        |            |
| <b>Summer</b> |                   |            |            |
| - sorghum     | 5–20              | 12         |            |
| - sunflower   | 2–8               |            |            |
| - mungbean    | 2–6               |            |            |
| - cotton      | 0.125 bales/mm/ha |            |            |

**Worksheet 1.** Moisture available and value.

How much soil water have you got and what is it worth? [Five step process]

|    |                                          |            |
|----|------------------------------------------|------------|
| 1. | Soil water available to your crop plants | ..... mm   |
| 2. | Expected in-crop rainfall                | ..... mm   |
| 3. | Expected total water supply to your crop | ..... mm   |
| 4. | Expected yield                           | ..... t/ha |
| 6. | Expected gross margins                   | ..... \$/h |

**Worksheet 2.** Soil water available—using push probe.*2. Estimating soil water available to your plants with a push probe*

Water available to plants = Depth of wet soil x Water available to plants when soil is fully wet  
 = .....cm x .....mm of water/cm of soil in root zone  
 = ..... mm of water

Therefore stored water available to PLANTS

= \_\_\_\_\_ mm

**Worksheet 3. Expected rainfall during crop season.**

3. How much rain can you expect while the crop is growing? e.g. Jandowne – monthly rainfall (mm)

| Season      | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Wettest 20% | 129 | 118 | 108 | 61  | 53  | 62  | 62  | 51  | 54  | 82  | 104 | 161 |
| Average     | 89  | 77  | 67  | 38  | 35  | 39  | 38  | 29  | 34  | 56  | 70  | 97  |
| Driest 20%  | 42  | 26  | 27  | 8   | 9   | 10  | 11  | 7   | 9   | 21  | 25  | 36  |

Period of crop water use: Month for planting = .....

Month when crop stops using water = .....

Expected in-crop rain: Average year = .....mm

Wet year = .....mm

Dry year = .....mm

**Expected in-crop rain** = .....mm

**Worksheet 4. Water supply for the crop.**

4. What total water supply can you expect for the crop?

Total water supply to the crop = Stored soil water available at planting + Expected in-crop rain

= .....mm + ..... Mm

= .....mm

[Repeat the calculation for average, wet and dry years]

**Other worksheets used for farmer calculations**

5. What yields could you expect this season?

6. What gross margins could you expect this year?

**Reference materials**

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## KNOW YOUR ... SOILS / SOIL BIOLOGY / FARM HYDROLOGY

**Gaye Chambers**  
**Land Management Society Inc.**

### Background

The Land Management Society (LMS) has been conducting the Know Your ... workshops for six years, beginning with the Know Your Soils workshop. This workshop was devised by Professor Bob Gilkes, Soil Science, University WA as part of his research for the *LMS Farm Monitoring Handbook* and was revised in 1998. All the workshops complement the LMS Farm Monitoring Kit (subject of a separate article in this publication and information also available from the LMS website) and all the measurements and tests have been brought into line with those included in the kit.

The Know Your Farm Hydrology and Know Your Soil Biology workshops resulted from a survey of LMS members and landcare personnel, who were asked to nominate subjects they needed to know more about. Hydrology and soil biology topped the list.

A number of Landcare groups and a mining company's revegetation staff have undertaken workshops. Farm Bi\$ evaluations include such comments as 'very relevant information', 'very helpful'. Other comments include, particularly with the Soil Biology workshop, 'I want to know more', 'we need to do something about increasing our soil animals', 'it's such good value'.

### The workshops

All the workshops are in modular format; with participants being offered a choice of modules (e.g. Know Your Soils includes modules such as field texture, soil ready reckoner, soil acidity, soil and water salinity, soil structure and decline, hydraulic conductivity of soils).

Each participant is issued with a comprehensive workshop manual. The workshops are presented by a qualified person who will supply the equipment needed. The workshops are only available from LMS.

The emphasis is participation and hands-on activity (e.g. Know Your Soils participants bring soil and water samples from their property and conduct observations plus analysis for pH and salinity). Know Your Soil Biology participants bring soil samples for examination under microscopes.

Community Landcare Coordinators are often the facilitators of workshops. Publicity is via our bi-monthly *News*, posted to 600 people involved in Landcare, plus email and fax contact with Community Landcare Coordinators, and local rural shows.

### Objectives

To give landholders practical, applicable information about their soils, hydrology and soil biology and so assist them with management decisions about their natural resources.

To encourage collaborative research through better farmer knowledge and communication.

### Tool concept

- One-day (6 hour) workshops on each topic, at the request of farmers
- Currently the workshops attract 50% subsidy from WA FarmBi\$
- Approximate cost per bona fide farmer is \$120/person, with 10–20 participants

All workshops take place in a local hall (soils and soil biology) or on a local farm (hydrology). Local specific information, such as soil types, are included.

LMS contracts experts in their field to present the workshops (e.g. Associate Professor Lyn Abbott, University of WA, presents the Know Your Soil Biology and a consultant in hydrology and environmental science presents the Know Your Farm Hydrology). Typical workshop outlines are shown below.

### **Workshop Outlines**

#### **LAND MANAGEMENT SOCIETY: KNOW YOUR FARM HYDROLOGY WORKSHOPS**

1. Water basics. Overview. Water flow in soil. Piezometers and bores. Aquifers and aquitards.
2. Water quality. Groundwater chemistry. How can I improve my water quality for aquaculture, horticulture, stock, irrigation? Conservation—remnant vegetation. Maximising water resources.
3. Water balance. Dams, banks and drains. Water harvesting. Tillage practices impact. Water tables.
4. Water cycles. Climate. Storm events. River systems. Paleochannels—old drainage systems.
5. Optional. Water rights and laws. Controls on drainage and other water regulations. Who owns the water? New opportunities.

#### **LAND MANAGEMENT SOCIETY: KNOW YOUR SOILS WORKSHOPS**

1. Soil texture. What is soil texture and what does it tell us. Hands-on learning to field texture a wide range of soils. Use of texture cards.  
45 minutes
2. Soil ready reckoner. A straightforward method for identifying properties that may affect management at any site, using the four profile hydrology groups.  
30 minutes
3. Distinctive features of the soil and practical implications. What do readily observable features of the soil, such as colour, texture, gravel and mottles, imply about soil properties and management?  
30 minutes
4. Soil water and acidity. Causes and effects of soil acidity. Hands-on measurement of soil acidity with pH meters, calibrating the meter, interpreting the result, sub-surface acidity.  
1 hour 30 minutes
5. Soil and water salinity. Hands-on measurement of soil and water salinity using a portable EC meter, calibrating the meter, interpreting the results, other indicators of soil salinity (vegetation, depth to watertable)  
1 hour 30 minutes

6. Soil drainage (waterlogging). Demonstration of the measurement of hydraulic conductivity of the soil.  
1 hour
7. Main soils and parent materials of local area. A discussion of the main soils and parent materials in the catchment. Implications for management.  
1 hour
8. Soil structure. Decline. Causes of soil structure decline, susceptible soils, field observation. Hands on use of slaking/dispersion test.  
1 hour
9. Water repellence. Causes, susceptibility of soils, field observations. Hands-on measurement of water repellence, using LMS water repellence test kit, management options.  
1 hour
10. Wind erosion. Susceptibility of soil and landform to wind erosion, processes of wind erosion, effect of wind-breaks. Hands-on monitoring of paddock status.  
45 minutes
11. Soil pits. Understanding soil profiles, sub-soil structure, indicators of water-logging, where roots grow, recharge process.  
2–3 hours
12. Soil groups. A user-friendly alternative for describing soil types rather than using native vegetation.  
45 minutes

#### LAND MANAGEMENT SOCIETY: KNOW YOUR SOIL BIOLOGY/SOILS ARE ALIVE WORKSHOPS

Throughout the workshop demonstrations and practical laboratory work will be alternated with group discussions and collective evaluations of material on various topics. Interactive sessions will be used to maximise participation of farmers and to allow them to use their own knowledge and experience in evaluating the demonstration and background information presented.

1. What is in soil and what does it do? Introduction to soil fertility  
This introduces the complementary components of soil fertility—physical, chemical and biological. It will include a discussion of the significance of soil biological fertility in land management.
2. Biodiversity in soil. This will introduce the types of organisms in soil, and the relationship between them. The effects of soil management on soil biological diversity and the different techniques that are used to identify them will be evaluated and compared.
3. Soil as a habitat for living organisms. The soil will be examined from the perspective of a habitat for living organisms. Techniques for quantifying soil organisms will be reviewed.

4. Activities of soil biota. An overview of the different roles of soil biota will be presented. Techniques for measuring soil biological activity will be considered.
5. Soil and land management: implications for soil biological fertility. Principles for land management to sustain soil biological activity will be discussed. Microbial indicators of sustainability will be discussed. Practical methods for managing soils to maximise soil biological activity will be evaluated.

**Further information**

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Workshop outlines are available on the LMS website [www.lmsinfo.com](http://www.lmsinfo.com)

## MANAGING SODIC, ACIDIC AND SALINE SOILS

**Rob Binns, R. John Petheram**

**Longerenong College, University of Melbourne, Horsham**

### Tool developers

P. Rengasamy and John Bourne (1997)  
Cooperative Centre for Soil and Land  
Management, Adelaide.

### Introduction and example use of the tool

In north-western Victoria, salinity, sodicity and acidity problems commonly occur in soils in the same general area. This leads to confusion amongst landholders, and often to incorrect diagnosis of problems, and hence inappropriate soil and crop management and reduced yield and profits. The SAS kit has been used successfully with many farmer groups undertaking farm planning courses in areas where sodicity is rife but little understood, and salinity and acidity are common. The activity involves some explanation of concepts, and also soil sampling by farmers prior to the half day SAS activity

### The participatory process

#### Prior session

1. Participants mark approximate land type boundaries on air photos/maps of their farms.
2. Instruction on hand-texturing of soil—using chart in kit and a range of sample soils.
3. Participants are asked to collect proper soil samples (top soil and sub-soil) from two of their main land types, and to bring these to the following session.
4. Instructions on a proper soil sampling procedure are provided and demonstrated.

#### The SAS kit activity

5. A brief session on theory of sodicity, acidity and salinity (definitions, diagrams in kit).
6. Demonstration of soil texturing technique.
7. Demonstration of turbidity test, using SAS Kit and 2 soils of contrasting sodicity. Participants prepare their soil samples for sodicity

### Objectives

To enable farmers to personally assess the condition of soils on their land, with regard to sodicity, acidity and sodicity. Encourages comparison of different land types, and discussion of management options for soil problems.

### Other learning outcomes

- Improved understanding of important soil and land management issues.
- Improved skills in communication and for learning in groups.

### Tool type

- SAS kit and instruction booklet, used with samples of farmers' own soils

### Materials

- SAS kit and instruction booklets, Ec and pH meters (& pH kits)
- Kitchen scales
- Soil samples from farmers (surface and subsoil)

Available from:

P. Rengasamy and John Bourne

CRC for Soil and Land Management

PMB 2, Glen Osmond, South Australia 5064

Telephone: (08) 8303 8670; fax: (08) 83038699

Email: creslin@adl.soils.csiro.au.

test and leave to settle (4 hrs).

8. Demonstration of use of hand-held meters for pH and salinity (Ec) - using two soils of recently tested pH & Ec. Results recorded on Record Sheet from SAS Kit.
9. Participants prepare and test their own soils, and record results on record sheets.
10. After adequate settling time, participants test samples for sodicity, and enter results.
11. Participants examine their results and may offer these for comparison on whiteboard.
12. Discuss the range of results from group for each variable (sodicity, acidity, salinity).
13. Discuss relationship of each problem to land types in region.
14. Discuss management options for each problem area (and land type), costs, etc.
15. Provide evidence from research, on costs and benefits of remedies and treatment.

#### **Description of the SAS kit**

The SAS kit consists of a cylinder containing a 'turbidity meter' (see Figure1) to assess the sodicity of soil samples, as well as a 14 page booklet with description of the all the tests needed in this activity. The contents of the booklet are summarised below, and some recoding forms are reproduced on pages 3 and 4 of this description.

#### **Contents of the instruction booklet**

- . Maps showing sodicity, acidity and salinity in Australia.
- . Field tests for turbidity, acidity and salinity.



Landholders practise hand texturing.

- . Measuring the problem:
  1. Turbidity test for sodicity
  2. Ec for salinity
  3. pH for acidity
- . Tables to identify major problems in surface or subsoil.
- . Results sheet (see third page).
- . Guide to controlling the problem (see page 4).
- . Rates and application of lime and gypsum .
- . Dealing with saline soils.
- . Identifying soil textural classes.
- . Conversion factors for EC units.
- . Effect of soil salinity on plant growth.
- . Tolerance of plant species to soil acidity.

**Additions needed to current instructions in booklet**

- . Instructions for sampling soils (surface and subsoil).
- . Give warnings on care over use of neutral, non-saline water in tests .
- . Give warnings on standardising hand EC and pH meters (also use CaO test).
- . Check meters and soils to be certain of EC and range of EC values in the area.
- . Use (tested) digital kitchen scales rather than expensive balances.
- . Prepare a collection of sample soils from different areas (for texture and other tests).

**Reference**

Rengasamy P. and Bourne J. 1997. Managing sodic, acid and saline soils.  
Cooperative Centre for Soil and Land Management, Glen Osmond,  
South Australia.



A farmer using the turbidity meter prior to main SAS kit session to test sodicity to test his sub-soil.

Sheet showing method of analysing results of tests, and a framework for deciding on management options for soils with different problems.

### Your results

(tick the appropriate boxes)

|                                                                            |          |         |          |         |          |         |
|----------------------------------------------------------------------------|----------|---------|----------|---------|----------|---------|
| Paddock name or number                                                     |          |         |          |         |          |         |
| Date                                                                       |          |         |          |         |          |         |
|                                                                            | Sample A |         | Sample B |         | Sample C |         |
|                                                                            | Surface  | Subsoil | Surface  | Subsoil | Surface  | Subsoil |
| Cloudiness or Sodicity                                                     |          |         |          |         |          |         |
| Not sodic                                                                  |          |         |          |         |          |         |
| Sodic                                                                      |          |         |          |         |          |         |
| Highly sodic                                                               |          |         |          |         |          |         |
| Electrical conductivity                                                    |          |         |          |         |          |         |
| 0.4 and above for sands/loams                                              |          |         |          |         |          |         |
| 0.7 and above for clays                                                    |          |         |          |         |          |         |
| below 0.4 for sands and loams                                              |          |         |          |         |          |         |
| below 0.7 for clays                                                        |          |         |          |         |          |         |
| pH (water)                                                                 |          |         |          |         |          |         |
| below 5.5                                                                  |          |         |          |         |          |         |
| 5.5 - 8.5                                                                  |          |         |          |         |          |         |
| above 8.5                                                                  |          |         |          |         |          |         |
| Likely most important problem                                              |          |         |          |         |          |         |
| <small>Write in the most likely problem from the diagnostic table.</small> |          |         |          |         |          |         |

### Controlling the problem

Examples of commonly found soil profiles and what to do

Is your soil....



You need to....

|      |                  |        |         |
|------|------------------|--------|---------|
| acid | acid             | acid   | neutral |
| acid | sodic (alkaline) | saline | acid    |

- add lime
- add lime first then add gypsum
- add lime • lower water table
- add lime



You need to....

|                  |         |                  |                  |
|------------------|---------|------------------|------------------|
| neutral          | neutral | alkaline         | sodic            |
| sodic (alkaline) | saline  | sodic (alkaline) | sodic (alkaline) |

- add gypsum
- lower water table
- grow acidifying legumes • add gypsum
- add gypsum



You need to....

|        |                            |                           |                         |
|--------|----------------------------|---------------------------|-------------------------|
| sodic  | saline                     | saline & sodic            | Highly sodic            |
| saline | with any other combination | saline & sodic (alkaline) | Highly sodic (alkaline) |

- add gypsum • lower water table
- control salinity before adding gypsum or lime
- control salinity • try test areas of gypsum
- add gypsum

Managing sodic, acidic and saline soils 7

## CROP MONITORING FOR PROFIT

**Harm van Rees**

**Agronomic consultant, Technical Adviser to Birchip Cropping Group  
Chairman, TopCrop Victoria**

### Introduction

Crop production groups have, since the 1960s, set production targets and developed management practices to reach these targets (e.g. the Five Tonne Club). The problem with these targets was that in a dry year the limit of production was not necessarily management but lack of rainfall (unless the crop was irrigated). It was not until the late 1980s that production targets were set more realistically against available rainfall rather than an overall yield. Two South Australian researchers, French and Schultz, developed the water use efficiency (WUE) concept in which crop performance was expressed as the yield produced per mm of rainfall (with units of kg/mm/ha). The optimum yield for wheat was considered to be 20 kg/mm/ha. This meant that for every millimetre of growing season rainfall (after allowing for evaporation) a wheat crop should be able to produce 20 kg of grain. This WUE value for wheat has held since that time and is widely used to compare paddock performance over a wide range of climates and soil types. WUE values for other crops have also been developed. The adoption of a robust indicator such as WUE enabled the development of crop checking programs to evaluate crop management and performance.

The Maximum Economic Yield (MEY-Check) crop monitoring program developed in the late 1980s used the WUE principles as the benchmark for production. By 1992 some 1200 paddocks in Victoria were monitored, crop growth, inputs and production were recorded and analysed using WUE criteria. It was the aim of the program to identify the factors limiting production so that these could be addressed in following years. In the mid 1990s the crop monitoring program TopCrop was adopted nation wide and farmers throughout Australia are involved in this program.

### Objectives

To enable participants to identify the key factors limiting or enhancing production.

To enable participants to bench-mark production performance against other paddocks.

### Other learning outcomes

- Improved understanding of how crops grow and perform in relation to soil, climate and other environmental factors.

### Tool type

- Farmer groups undertake crop monitoring activities, using TopCrop guides and materials, facilitated by a TopCrop or agri-business facilitator.

### Materials

- TopCrop crop monitoring guides
- Recording material
- Ruler



Monitoring during early phases of wheat development for diseases and weeds can assist in making decisions on need for fungicide applications, nutrient adjustments and weed control. Keeping records of these problems can greatly improve decisions in following years. For example, many diseases are carried over from year to year, so making a record of disease type and levels will help in deciding on a cropping program next year.

## Example use of the tool

### The participatory process

#### Prior session

- Farm group identifies local needs for crop improvements.
- Farm group works with a TopCrop coordinator or agri-business representative to ensure the monitoring procedures are in place and the recording sheets are available.
- The group agrees on a timetable of meetings that correspond to the critical monitoring times (i.e. seedling emergence, weed populations, in-crop disease assessment etc).
- The participants need to provide a three year history of the paddock (crop rotation, varieties, yields, inputs).

#### In paddock activities

- Soil sampling for nutrient analysis and disease levels.
- Farm group meets at each crop assessment time to learn how to monitor, record and interpret. Participants then go back to their own paddock to complete assessment.
- Farmers harvest paddock and complete recording sheets (including inputs, rainfall etc). Recording sheets to be handed in to coordinator for analysis.

### Operation of a monitoring program

- In the first year of monitoring, a farm group usually selects a crop that everyone is growing and is comfortable with (e.g. wheat). In subsequent years, a new crop for the region may be chosen (i.e. a crop for which not much is known and where large production gains can still be made). It is essential that all group members monitor at least one paddock with the chosen crop type.
- For most crops there are five in-paddock assessments or checks to be made:

#### Pre-season (March or 8 weeks before sowing)

- Soil testing for fertility and disease
- Paddock selection
- Seed quality

#### Crop establishment (June or 3–6 weeks after sowing)

- Seedling population
- Sowing depth
- Weeds, disease and insects

#### Crop nutrition and vigour (July/August or 8–12 weeks after sowing)

Plant nutrient levels (tissue analysis)



When growing new crops such as lentils it is essential to find out the cause of problems in early years. This will help avoid costly mistakes next year. In this case the lentils on the left of the photo were affected by high concentrations of boron in the subsoil.

- Weeds, disease and insects
- Plant tiller or lateral counts
- Legume nodulation

#### **Flowering and disease (September or 15–18 weeks after sowing)**

- Head or pod number
- Root and leaf disease
- Weeds (assessment of control, burden for coming season)
- Insects

#### **Harvest**

- Yield
- Grain quality, grade
- Record all inputs
- Rainfall
- Previous paddock history
- Results can be analysed by coordinator using TopCrop software.



Digging a trench and seeing where roots are growing is a great way to stimulate discussion and get a better understanding of crop response to rainfall and other limitations.

The outcomes will be:

- individual paddock performance indicators (i.e. WUE achieved, nutrient balance, gross margin, possible factors limiting production);
- individual paddock performance in relation to the other paddocks in the group and the monitoring program and development of benchmarks for production;
- interpretation of the results with other group members and discussion of how to improve production and financial outcomes;
- information used to help make crop/variety and input selection for the next years crop.

#### **Examples of topics for a crop monitoring program**

- Germination testing and seed weights for optimum plant population.
- Optimum performance of wheat and malting barley in relation to nitrogen inputs
- How to grow new crops such as lentils (to identify the critical limiting factors in the production of lentils or any other new crop)
- Optimum sowing rates, row spacings, nutrition for different crops and varieties
- Benchmark the performance of a particular crop/variety over three years
- Benchmark particular paddocks and rank them according to their productivity

### **Life after crop monitoring**

Many farmers have completed several years of extensive crop monitoring and now have a much better understanding of how crops grow, what affects crop growth, how to tailor inputs to crop needs and how to set realistic yield targets. Many of these farmers are still actively involved in furthering their knowledge of their production system. Some have started:

- . looking at the soil and how soil factors such as the physical, chemical and biological nature of the soil affects crop growth (see photo)
- . starting their own in-paddock trials of new techniques (see article on on-farm trials)

### **SOME COMMON OUTCOMES OF CROP MONITORING**

- ✓ Greater understanding of factors limiting production and, through discussion and use of TopCrop guides, the opportunity to develop a plan to overcome problems affecting production.
- ✓ Benchmarking production performance provides an impetus to further improvement.
- ✓ Setting of more realistic yield targets and input levels.
- ✓ Avoiding failures with new crops.

### **SOME KEY POINTS ON CROP MONITORING**

- ✓ It is always beneficial and more enjoyable for individuals to work in a farm group with TopCrop coordinators or with local agri-business. Agronomists can help in making the monitoring program clear and useful. Decisions regarding in-crop management are often a beneficial outcome of in-crop checking.
- ✓ Always monitor away from headlands, trees, etc.
- ✓ The outcome of a monitoring program is only as good as the records provided kept.

### **For information on TopCrop monitoring:**

- . Contact local agri-business or Agriculture Department Office.

## FARM ENVIRONMENTAL MONITORING KIT

**David Chambers**

**Land Management Society Inc.**

### The kit in context

The farm monitoring kit is part of a farm monitoring program that started in 1988. For the following four years Professor Bob Gilkes, Department of Soil Science, University of WA contracted to research and deliver the *Farm Monitoring Handbook* in 1992. In 1994 an Land Management Society (LMS) committee requested farmers to select a suite of tests/ measures from the handbook to be incorporated into a kit that would best suit their understanding and management of natural resources.

The kit has two roles:

1. short-term assessment for production decisions (e.g. assessing the infiltration effectiveness of different tillage);
2. long-term trend assessment for the management of natural resources responses.

Curtin University Environmental Biology students tested the kit to ensure that the procedures and measures were simple and repeatable. A pilot program placed 25 kits on farms during 1996. Follow-up workshops defined the need to create a one-day introductory workshop. From 1997 to 1999 National Landcare Program funded a program that placed a further 175 kits on farms with supportive training. In addition 300 water table sampling kits have also been placed in catchments.

A 1999 survey of kit owners indicated 95% were monitoring with tests of their choice. A few were monitoring within the integrated intention of the kit. It was very apparent that encouragement from agencies such as Agriculture WA is important and that the perceived and actual benefits are still developing in terms of long-term and complete adoption. Adoption is very much a personal decision by a farming family.

The kit comprises many locally designed and manufactured tools such as the water table sampler. Details are available from the LMS website: [www.lmsinfo.com](http://www.lmsinfo.com)

### The kit configuration and information focus

The kit comprises two packages:

#### Field package

- Contains all the step-by-step instructions and tools required to obtain field samples that are returned to the homestead for analysis.

### Objectives

To simplify and standardise the management of on-farm natural resources by providing a kit of procedures and simple but robust tools.

To encourage farmers to take ownership of natural resource management as a normal function within the annual farm production cycle.

To provide an objective means of identifying natural resource responses and trends that result from agricultural and weather impacts.

To provide farm scale natural resource data for collaborative research and application to catchment and region scales.



The Land Management Society field package monitoring kit

- Constructed so that it can stay on the farm utility. The kit is water resistant and can be carried in back pack for motor cycle mobility.

#### Homestead package

- Contains step-by-step instructions and tools for processing and analysing field samples.
- Climatic events are also recorded at the homestead.



The Land Management Society homestead package kit.

#### Information focus

The kit has four information groups that help the farmer establish inter-relationships:

- climatic events (weather impacts): rain, damaging winds and frost;
- responses: water table, sheet erosion, dams, streams;
- soil condition (responses to agriculture): water repellence, water infiltration, soil structure, compaction, acidity, salinity, ground cover and earthworm count;
- outputs (crop and pasture yields).

A sample recording sheet for soil condition and outputs is on page#

#### **Use of the kit**

The process of application is:

1. The LMS promotes farm monitoring through catchment groups, Landcare Coordinators, agencies, agricultural shows, publications, and group presentations.
2. A group of farmers in a catchment decide to objectively monitor and manage natural resources. The local catchment group or Landcare coordinator are often the initiators/facilitators.
3. Each member of the group purchases a kit and attends a one-day on-farm workshop. The price of the kit includes the workshop and both are subsidised by FarmBi\$ in Western Australia.
4. Each farmer selects an area to monitor (e.g. a production area that includes a resource problem that needs to be addressed or is planned to be so). Fixed monitoring sites are established (usually 6 to 8 sites). These sites are identified on a sketch map to assist the monitoring task and possible delegation.
5. A kit wall chart can be used to mark target monitoring dates (i.e. water table monitoring once a month for the first year, quarterly in

following years; soil measurements are made once a year, some in the dry season and others in the wet season).

6. All measures and calibrations are recorded for each year.
7. Interpretation is usually simple and assisted by the *Farm Monitoring Handbook* (part of the kit). Where interpretation indicates a need for expertise the LMS can refer to specialists.
8. Attending three awareness courses will enhance understanding and recognition as to what resources may be required. The Society provided courses are:
  - . Know Your Soils
  - . Know Your Hydrology
  - . Know Your Soil Biology (Soils Are Alive)

Details of the courses are the subject of a separate paper (page. ) and can be accessed on the LMS website: [www.lmsinfo.com](http://www.lmsinfo.com)

9. A solution is applied and monitoring continues to verify performance or impact.
10. Phone, workshops and a quarterly *Monitoring Bulletin* achieve follow up.
11. Condition and trend data that are primarily used on-farm but can be shared with catchment and region. These data can be used by researchers to verify the impact of farm practices and any changes implemented.

#### **SOME BENEFITS TO DATE**

- ✓ Increased knowledge and understanding of natural resource management and responses.
- ✓ Objective data to confirm practices and actions/ solutions at farm and catchment levels.
- ✓ Trend data that will assist the farmer to benefit from developing financial and marketing benefits.

#### **DEVELOPING BENEFITS**

- ✓ Financial reward from banks and real estate where objective measures can be provided.
- ✓ Market access and best price via a developing Australian Environmental Management Systems process.

**References**

Hunt N. and Gilkes B. 1992. The Farm Monitoring Handbook, University of Western Australia, Perth.

Tassone R. and Kostas E. 1996. Assessing the Performance of the LMS Farm Monitoring Kit, Land Management Society, Perth.

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## MONITORING IPM: USING BENEFICIAL INSECTS

**Paul Horne**  
IPM Technologies Pty Ltd

### Introduction

Integrated pest management (IPM) is a means of controlling pests without relying totally on chemical insecticides. It has been developed for some crops in Australia over the past few years and is being used successfully by growers in many parts of Australia. For many years the main approach farmers used to control pests consisted of either routine and frequent applications of insecticide, or else waiting until there was a problem and then attempting to eradicate the pest concerned. The approach that IPM takes, is to look carefully for pests throughout the season and make decisions on what to do, based on monitoring the results.

The difficult part for most people to understand at first is that some pests are always present in a crop, without necessarily causing damage. Just how many can be tolerated varies with many factors, including location, variety and nearby crops. When a potentially damaging level of pests occurs then the question becomes what to do about it. In an IPM strategy, the best control measure is not necessarily what kills the most pests most quickly, but what will give the best control while giving least disruption to other pest control measures.

Pest and disease problems vary considerably in terms of pest problems—between type of crop grown, regions, and even paddocks within a district. Integrated pest management deals with any combination of pests encountered, by using appropriate combinations of control methods. The key is being able to accurately and confidently predict the level of risk to a crop: this can only be learned by growers and specialists jointly monitoring pests and beneficials in a crop.

### The process

The initial stage involves a grower or grower group wanting to use IPM. Contact is made with an IPM specialist who can guide the participants through its use. The grower and specialist together develop an appropriate strategy for each

### Objectives

To allow farmers to develop confidence in IPM and their ability to adopt and manage it.

To help participants to learn how to recognise, manage and utilise beneficial insects from their own crops.

### Other learning outcomes

- Improved management techniques for control of pests
- Improved ability to select appropriate insecticides and miticides

### Tool type

- On-farm monitoring of whole crop. Grower and advisor monitor crop weekly for pests and beneficial species. Key pests are identified, and the numbers of these and their major natural enemies are monitored as a basis for decision making on pest management.

### Materials

- Grower interested in reducing reliance on pesticides
- Commitment to undertake regular monitoring
- Crop for monitoring
- Sampling methods appropriate for the crop and pest complex
- Insect and mite identification kit
- Monitoring record sheets
- Pheromone traps and baits

### BENEFITS

Benefits of developing and adopting an IPM monitoring strategy include reduced pesticide hazard to users, the environment and neighbours; reduced risk of residues in food; and reduced costs.

Individuals using IPM have made vast reductions in chemical costs. For example, one individual potato grower estimates savings on insecticides alone to be worth \$55 000 over the last five years. That does not include estimates for all other benefits listed above, but is simply the savings on the cost of chemicals that would have otherwise been purchased.

situation. The time to begin is either at the start of a crop, or at a time when pest pressure is low.

The site may be a crop or paddock with a history of pest problems. It is necessary to look at what the control methods (pesticides applied) were in previous years, to allow a comparison at the end of the trial.

It is necessary to identify the key pests, which may or may not be known by the growers or the IPM specialist at the start. Even if the main pests are known, it is necessary to monitor for all potential pests as the pest complex can be very different if the pesticide regime is altered (e.g. the main pests that occur under a program of frequent insecticide application will be different to those occurring if biological control agents are used as the main tool). Monitoring will usually be carried out using several different methods. Each will be explained and growers will learn how to collect suitable data.

Decision making, based on the data collected, is the most difficult stage, and the decisions will vary from grower to grower. Given any set of pest and beneficial insect numbers, other factors will influence the perception of risk, and hence the decision on appropriate action. The co-development of site-specific IPM strategies means that there is no strict protocol for assessing

risk. Instead, the IPM specialist and grower will decide on risk factors together.

#### **SOME KEY POINTS IN MONITORING FOR IPM**

- ✓ Ensure there is grower commitment to using IPM
- ✓ Conduct the sampling at the same time each week, with grower involvement
- ✓ Ensure that the participants are able to see the beneficial insect populations developing in their own crop
- ✗ Do not use spray equipment that has not been thoroughly cleaned (including aircraft).

The participants will learn how to monitor and then how to use the information they collect; and to be precise in identification of pests, beneficial species and benign species (see Figure 1 example of monitoring sheet). Growers become able to precisely target control measures and develop cultural techniques that improve pest control and beneficial management. They will learn (with the specialist) how to develop an IPM strategy that is specific for their crop, in their district.



IPM specialist Cindy Edward works with a family member on monitoring a potato crop.

**Figure 1.** Monitoring record sheet for potato crops.

**MONITORING RECORD SHEET FOR POTATO CROPS**

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Farmer: \_\_\_\_\_ Site \_\_\_\_\_

Phone: \_\_\_\_\_

---

| Date | Aphids/100 | PTM | Thrips | Moth eggs | Leafhoppers | Mirids | Loopers | Rutherglen bugs | Beneficials |
|------|------------|-----|--------|-----------|-------------|--------|---------|-----------------|-------------|
|------|------------|-----|--------|-----------|-------------|--------|---------|-----------------|-------------|

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## ADAPTATION TRIALS ON FARMS

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### Introduction: farm trials in general

Agricultural research in lower-income countries has seen a marked move away from research stations towards trials on-farms. This has been justified on the basis that:

- much technology developed purely on research stations has never been adopted;
- conditions and practices on research stations seldom represent farm situations;
- farmers cannot assess applicability of technology on stations as well as on their farm;
- many topics have been studied on stations and in laboratories but not tested on farm;
- working (even partly) on farms makes scientists more sensitive to farmers' needs;
- farmers working with scientists can lead to higher rates of innovation and co-learning than more traditional research approaches (e.g. Norman and Modiakgotla 1990).

Farm trials can never replace research station experiments for complex studies with numerous treatments, where control of variables is essential. However, all the points listed above may apply in certain situations in Australia, and the last two points appear to be gaining particular importance—as reasons for initiating programs of on-farm trials in Australian R&D programs.

*The commitment of farmers to a process involving design and conduct of on-farm trials may be seen as the epitome of participatory R&D and progress toward sustainable farming systems.*

Despite the growing acceptance of concepts of farmer participation in research, the topic of *on-farm trials* has received little attention in the Australian agricultural research literature—partly because it is seen as 'unscientific' by 'reputable' journals. Adaptation trials are just one type of farm trial. Clarifying the differences in aims between various types of trials and experiments may help to improve understanding and importance of concepts of on-farm research.

Ashby (1987) classified on-farm trials into the first three broad classes listed in Box 1, in terms of the type of participation by researchers and farmers in

### Objectives

To assess farmer opinion on the practicality and potential of new ideas.

To learn from farmers' attempts to adapt ideas to their farm situations.

To evaluate practicality of ideas from research stations, before wider dissemination.

To promote enquiry and innovation by farmers and farmer groups.

### Tool type

- An idea or technology is tested—according to a standard format—on several farms, but farmers are encouraged to adapt the idea to suit their situation. Although performance may be compared generally with standard practice, interest is mainly in farmers' opinion of the potential of the idea and in the adaptations made, rather than in statistical differences.

### Materials

- Usually normal farm equipment, except where machinery is the subject of the trial
- Trial layout, recording schedule and recording forms
- Camera

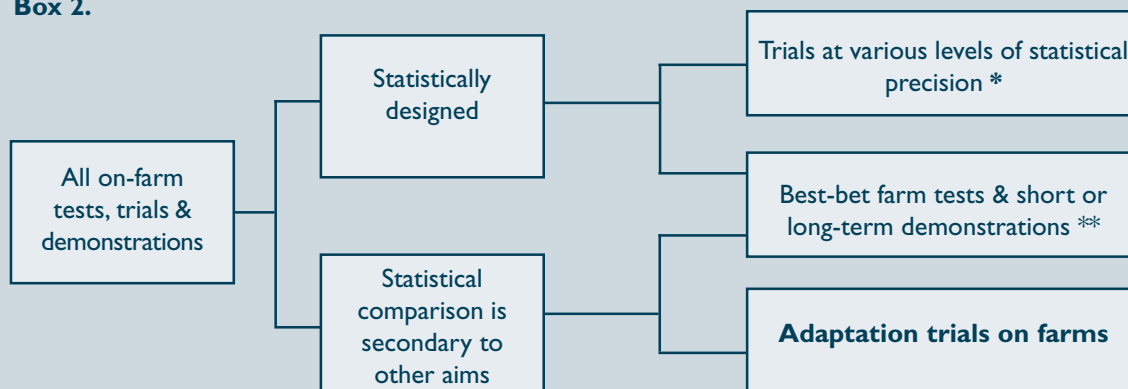
### Box 1.

1. Researcher designed, researcher run
2. Researcher designed, farmer run
3. Farmer designed, farmer run
4. Farmer designed, researcher run

their design and implementation. The fourth type listed is a variant commonly used in Australia, particularly in large farmer groups such as Southern Farming Systems (1999)—where the aims of trials are sometimes set by farmers but the trials are run mainly by scientists in relatively controlled situations on farms or demonstration farms.

The four categories in Box 1 imply different levels and types of participation (and ownership) by farmers in the design and conduct of farm trials. Adaptation trials on farms can fall under class 2 or 3, and their position in relation to other types of farm trial is shown in the broad classification of farm trials in Box 2.

## Box 2.



\* Farm trials designed at various levels of statistical sophistication are discussed by Blake et al (1990)—see *Test as You Grow* tool in this manual—and also by Hunter and Hayes (1996) for plant nurseries.

\*\* Long-term demonstrations on farms are not usually conducive to sound statistical analysis in the short-term but results over many years may improve statistical precision (see *Long-term conservation farming trial* in this manual).

## Adaptation trials

Adaptation trials on farms can be a powerful means of harnessing farmers' ability to adapt ideas or technology (new or from other areas) to suit their local farming conditions. The trials expose a group of farmers to a new idea, but instead of having a very rigid statistical protocol, there is scope for individuals to adapt the idea to suit their soil, seasonal conditions or equipment.

Because conditions on each farm will differ and farmers are encouraged to adapt the idea (e.g. a new implement, sowing method, feeding method) to their particular needs, statistically valid comparison (or interpretation) may not be feasible. **It is important to stress that the objectives of adaptation trials differ from those of other on-farm trials.** Measurements of inputs and performance are made, but **the main interest is in farmer opinion of the practicality of the ideas** (and adaptations made by farmers), rather than on statistical differences between treatments.

There is considerable scope for farmer groups to undertake adaptation trials on their farms, using PIRD (producer initiated R&D) grants and other funding aimed at promoting farmer innovation. The most interesting results

of such farm trials are often in terms of general progress of a group's learning about a topic, and can be quite unexpected – as illustrated in the following example.

### **An adaptation trial on tree establishment**

A group of Wimmera farmers obtained Landcare funding for farm trials aimed at improving the success of their efforts to re-establish Buloke trees on their properties. Three group members each volunteered to fence two sites on their farms—one under Buloke woodland and one on land cropped for many years. On each site, three types of tree establishment were used—direct seeding, standard seedlings and 'speedlings'. A standard layout was used at each site but soil conditions and weed intensity varied between sites, as did rainfall after planting. Numbers and height of surviving trees were recorded at various dates and group meetings were held to discuss these results.

In addition to natural variations between the sites, the three farmers used their own judgement as to when to weed and water the trees—according to local conditions and their past experience. All these differences in treatment meant that no rigorous statistical comparison could be made. Yet, by observing the trial and the trials and different responses on the three different farms, the group members were confident about the following general conclusions after the first year:

- . In a dry year standard seedlings survived and grew much better than trees planted by other methods.
- . Weed control is the most critical factor in survival of Buloke seedlings.
- . The weed seed bank on cropped land is much greater than under buloke woodland.
- . There is no obvious inhibiting or beneficial effect of planting under buloke.
- . Extra watering in the dry season can greatly improve tree survival.

These above conclusions are nothing new (and certainly lack statistical basis), but farmers place high value on visual observations from their own (or a group's) trials if they know the full circumstances of the trial. Although there is danger of misinterpretation of the results of such 'uncontrolled' trials, farmers tend to base their conclusions less on the numerical data from the trial than on their observations of what transpired under the practical conditions faced on each farm, and on discussions with the farmers involved. In this case the most important outcome of the trial was not planned at all.

### Box 3. Unexpected outcomes

The most important outcome came from two other farmers in the group who were inspired to run their own farm observations—and came up with an establishment method that surpassed all other methods—and is now being widely adopted by members of the group.

*Adaptation breeds innovation.*

### Box 4. Some notes on adaptation trials on farms

- Many research scientists have difficulty accepting the concept of non-statistically designed trials. **It is vital to clarify the (non-statistical) aims of particular types of trial with farmers and scientists involved both before the trial, and in interpreting the results.**
- Farmers who have seen multi-location trials (e.g. of varieties) run by researchers on farms for many years often expect researchers to take on all the work of trials on farms. **In working with adaptation trials, it is critical to clarify the expectations and responsibilities of each farmer and adviser (and volunteer workers) in the trial from the start.**
- Farmers or groups must be well aware of the work loads involved in running farm trials from the start. Where there is concern about the work load involved, they should be discouraged from taking part **without employing outside labour/help at the critical periods.**
- Recording of all farmer's actions is essential in adaptation trials.
- **Regular observation and discussion of the trial is needed in the case of group trials—**so that all members can have input into decisions about management, and hence retain ownership of the trial and its results.

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## TEST AS YOU GROW: A KIT AND SERVICE FOR BROADSCALE ON-FARM TESTING

**John Blake, Daya Patabendige, Ian Pritchard**  
**Agriculture Western Australia**

### Introduction

In the 1960s we had three crop types, a limited number of varieties and little flexibility in cropping systems or inputs. We now have more than double the number of crop types, a wide range of varieties (and grain segregations), rotations, many new cropping practices (direct drill, no-till, furrow sowing) and tremendous diversity and flexibility of crop protection systems. The need for research has expanded 'one hundred-fold'.

Programs on research stations and trials in each locality have not increased one hundred-fold to match the need. There is, therefore, a demand for on-farm testing to complement the programs of small plot experiments. Some farm businesses have an R&D component, part of which is for paddock testing. The Test as You Grow Kit can be used as a guide by farmers in their efforts to plan and run appropriate types of on-farm testing in their paddocks.

### Kit contents

- . *Test as You Grow* manual on planning and layout of trials
- . Fax Back form for access to design advice and biometric analysis support
- . Field clip-board, crop monitoring forms for data recording such as sowing germination, tillering, rainfall, spraying, yield, grain quality, etc.
- . Test as You Grow—regional contact guide (Western Australia)
- . Test as You Grow—registration (for materials)
- . Access to crop diagnostic services & company agronomists & consultants
- . Plans for grain weighing trailer (GRDC/TopCrop)
- . Application to join TopCrop West—crop management/analysis service
- . AGWEST Plant Laboratories—information pack on crop diagnostic services

### Objective

The Test as You Grow Kit is designed as a guide to make crop tests as simple, practical and valid as possible. It enables farmers to set up crop tests as they carry out normal cropping operations, with minimum disruption to the cropping program.

### Tool type

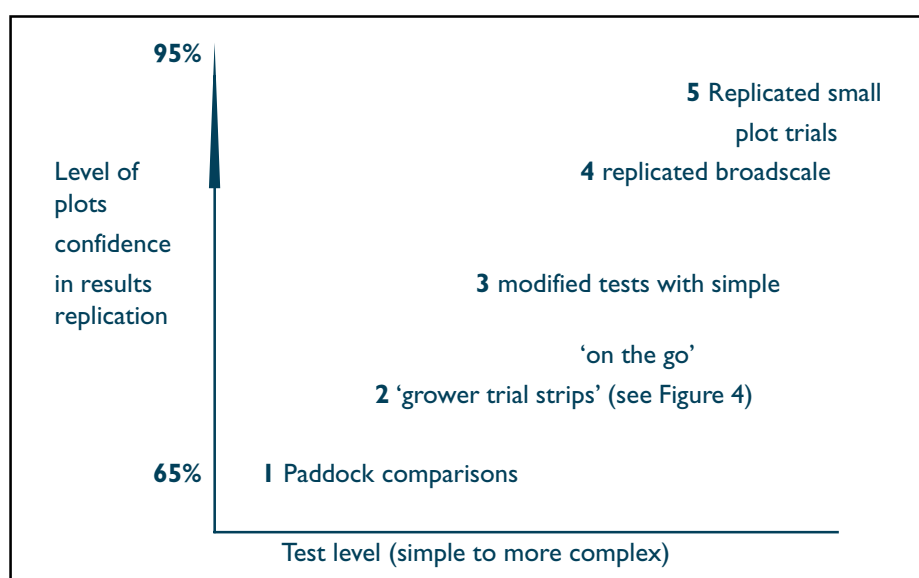
- . A kit containing a manual and supporting materials for use as a guide for groups or individual farmers, in planning their own on-farm tests and trials. Includes a fast-track (fax) system for seeking advice and resourcing tests (supported by GRDC project DAW599). Design suggestions are faxed back after consultation with a biometrician on how to achieve objectives with the simplest and most practical designs. Tests are registered and, where agreed, groups are able to exchange designs and coordinate tests. There is opportunity to link tests and gain greater statistical validity with simple tests especially where groups have similar objectives. Input from specialists is advised on trial design and interpretation of results.

### Source

- . The Test as You Grow Kit is available from TopCrop Development Officers in Western Australia. Under development in other states.

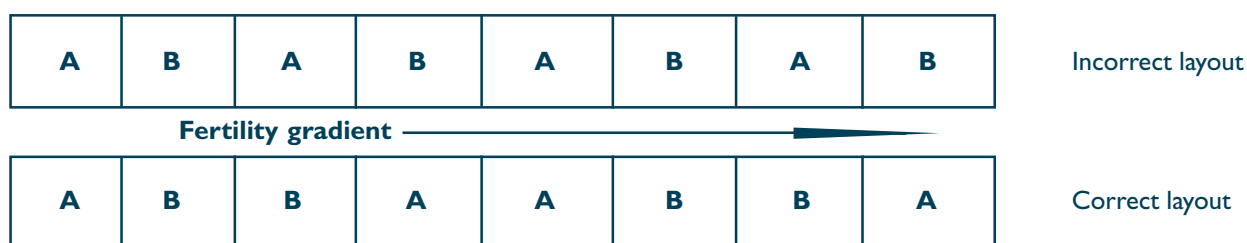
### Levels of sophistication of farm trials

Farmers and groups participating in on-farm testing will have need for different levels of sophistication in planning their crop test - from broadscale paddock comparisons to well replicated trials using small plots. In the *Test as you Grow* manual, Patabendige et al. (1999) explain that the level of confidence that can be placed on the outcome of a trial depends on the level at which the test is designed, and they provide a guide to the design of trails at five different levels. For example, in replicated small plot trials (Level 5) the probability that the results are true (and not due to chance) can be higher than 95%. In paddock comparisons (Level 1), the probability that results are true can be as low as 50%. In making decisions on the farm, the level of confidence to be placed on the results of a trial result should be based on the level at which the trial was designed. These five levels of sophistication of on-farm tests are depicted in Figure 1.



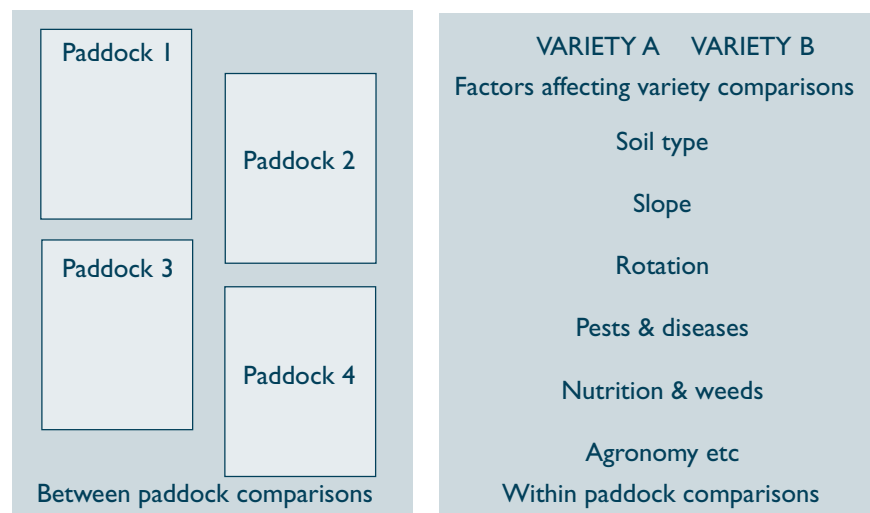
**Figure 1.** Levels of sophistication (and confidence) in on-farm testing.

The *Test as You Grow* manual explains some simple statistical principles, such as control of error in trials, and provides examples of hypothetical farmers and their trials. An illustration is given of incorrect and correct ways of laying out plots in relation to a fertility gradient at a trial site (Figure 2).

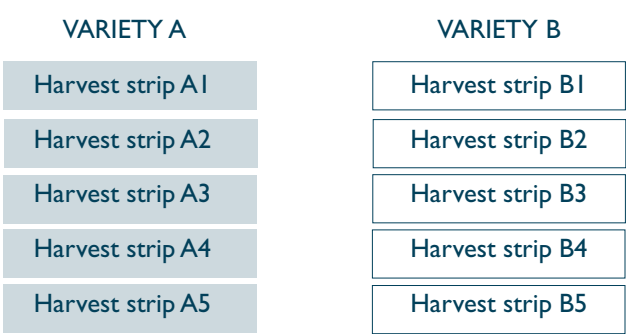


**Figure 2.** Hypothetical example of correct and incorrect layouts for a two treatment trial with four replicates, in relation to a fertility gradient (Patabendige et al. 1999).

For each of the five levels of sophistication shown in Figure 1, examples of layouts for farm trails are given in the *Test as You Grow* manual. Three of these examples are shown in Figures 3–5 with brief notes taken from the manual. The Level 4 and five layouts are not shown here but are available in the manual.

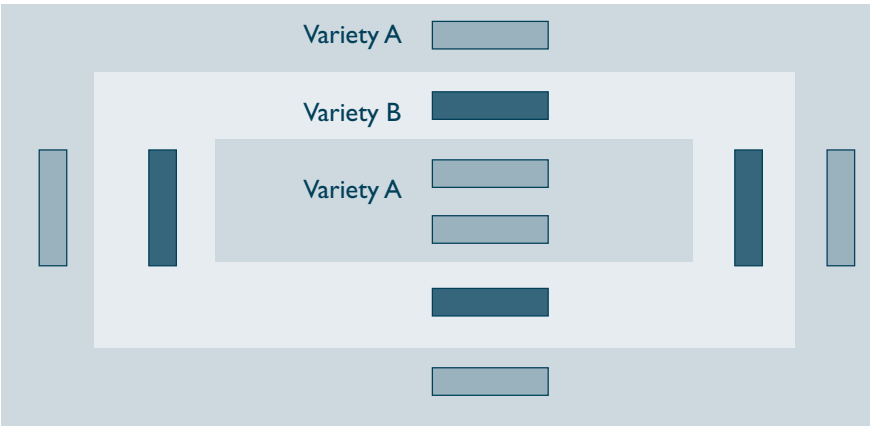


**Figure 3.** Two examples of types of layout of farm trials at level one and the factors affecting the validity of results.



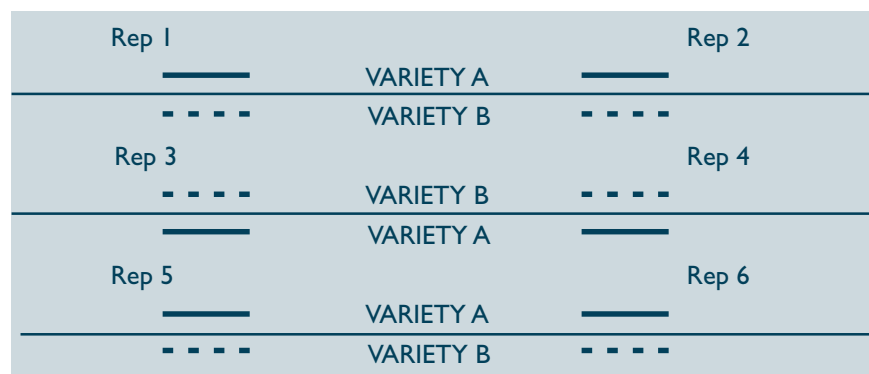
**Figure 4.** Level 2. Comparison of two treatments and harvesting paired strips.

The paddock is divided into two across-soil type differences so that both sides have the same fertility levels, and apply your own treatments. Treatments can be two varieties or two pesticides or plus and minus gypsum or lime. At harvest, mark out paired strips of equal area and harvest and weigh the strips separately.



**Figure 5.** Level 3. Variety comparisons – standard sowing.

The paddock is seeded in three sections as shown. The layout of the harvest plan (or plots) can be done in a less busy time. The strips should be harvested and weighed separately.



**Figure 6.** Example of Level 3 (2) variety comparison—line sowing.

### Other information in the kit manual

The Test as You Grow Kit Manual gives examples of more sophisticated trial layouts than those above (i.e. at the four and five levels of testing, as well as some general guidelines or requirements for each level). For instance, for Level 4 tests there are a number of minimum requirements, which will depend on the factor being tested (variety, seeding rate, chemicals, etc). Some standard requirements for varietal trials are:

- . the use of a standard variety as a control in every third plot
- . two replicates
- . a uniform site
- . accurate recording of test and site details

In addition, the manual contains a section on on-farm experimentation—*using precision agriculture technologies*. This concept offers two main benefits for farm testing:

1. yield monitors on headers linked to GPS and data loggers allow more accurate experiments to be carried out; and
2. variable rate technology can be used to design complex trails across whole paddocks – with minimum effort and without disrupting normal cropping.

The manual mentions a new publication on this topic available from GRDC by Bramley et al. (2000) and shows a useful flow-chart from this publication showing stages in the design of on-farm tests and experiments in general.

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## ON-FARM TRIALS

**Harm van Rees**

**Agronomic consultant, Technical Adviser to Birchip Cropping Group  
Chairman, TopCrop Victoria**

### Introduction and example use of tool

The way to encourage farmers to adopt new technology is for farmers to be actively involved in the testing of new practices using their own machinery, on their own soil type and rainfall. The best way is for a group of farmers to work together and test the new practice on their own farms. Many new practices can be tested in a controlled way using farm equipment. A group of farmers working together enables across paddock variability to be assessed to test how 'good' the practices are under a range of conditions. Working as a group also makes it easier to invite researchers to assist with setting up the tests and help with interpretation of the results.

A good example of on-farm participatory research undertaken by farmers was the TopCrop Victorian State Focus on malting barley in 1999. Seventeen farm groups undertook to establish large scale testing of best bet techniques on how to optimize the production of high quality malting barley. Researchers from DNRE (Department of Natural Resources and Environment) and SARDI (South Australian Research and Development Institute) were involved with the groups. Staff of DNRE and SARDI assisted with interpretation of soil test results for nutrient and disease levels, statistical analysis and interpretation of yield results.

### The participatory process

#### Prior session

- Farm group identifies local needs for technology adoption and selects one or two major needs for on-farm testing.
- Farm group works together with a TopCrop coordinator (or other facilitator) in designing the trial and to ensure that the necessary equipment is on hand (generally all that is required is normal farm machinery and a weigh bin).
- Select members within the group who are keen to participate with the on-farm trial (minimum number of sites required for testing a new practice is five).
- Prepare inputs required for on-farm trial (ie. seed, fertilizer etc).
- The group agrees on a set of monitoring and recording procedures to assess differences between treatments in the trial.

### Objectives

To encourage farmers to participate in new developments in the grains industry through active involvement with on-farm trials and demonstrations.

### Other learning outcomes

- Better understanding of new technology and how it impacts on crop production.

### Tool type

- Involvement of farmers in design of multi-location farm trials

### Materials

- Normal farm machinery
- Weigh bin (bin with scales to measure harvest loads) or yield monitor
- Flexible pegs (flexible for spraying)
- Paddock histories, recording schedule and forms

- The trial participants need to provide a three year history of the paddock (crop rotation, varieties, yields, inputs).

#### In paddock activities

- Prior to sowing soil samples to be taken from each site (analysis required depends on the on-farm trial to be undertaken).
- Farmers each sow trial paddock.
- Farm group actively involved in monitoring program (at least two crop inspections).
- Farmers harvest trial and weigh grain produced from each treatment using a weigh bin. Farmers keep grain sample (usually 1kg is sufficient) for further testing if required (protein, grain weight, quality etc).
- Results interpreted with research collaborators.

#### **Design of an on-farm trial**

On-farm trials need to be simple to undertake while providing good robust data on which farm management practices can be based.

It is difficult for farmers to sow and maintain fully replicated trials using farm machinery. In addition, fully replicated trials generally provide much more detail than required when adopting a new practice. Fully replicated trials also take up a lot of space in a paddock.

It is important that the trial undertaken is robust enough for farmers to have confidence in the results and that the outcome was not due to chance.

Every trial will be different but there are some useful guidelines for designing on-farm trials:

- keep the number of treatments manageable (more than six treatments becomes complicated and cumbersome).
- design the layout of the trial so that a treatment is always adjacent to a control (the control is usually the normal farmer practice).

For example a farm group wants to test four new wheat varieties. The normal variety grown in the area is X, so this variety is used as the control. The group would need at least five participants to contribute to the trial with the same design at each property.

| var 1                 | var X<br>Control 1 | var 2 | var 3 | var X<br>Control 2 | var 4 |
|-----------------------|--------------------|-------|-------|--------------------|-------|
| Minimum<br>100 m long |                    |       |       |                    |       |

Each plot is at least one header width wide

## Interpretation of the harvest yields

The yield of each variety is worked out as a percentage of the adjacent control variety. In other words, variety 2 is rated as the percentage yield of the adjacent Control 1. The same is done for the results at each of the five sites and the consistency of the results is then compared. This enables a reasonably robust analysis of the results between the five sites. If, for example, variety 3 yields more than the adjacent control (Control no 2 in this case) at each of the five sites, it would be a very good indicator that variety 3 was a better variety for the area. If variety 3 yielded more than the adjacent control at three out of the five sites, then unless there were specific reasons (e.g., disease) for this result, then you could not be as sure of how robust the new variety was, compared to the Control variety.

## Examples of topics for on-farm trials

- Nitrogen inputs on wheat (no urea, pre-drill urea, half urea pre-drilled the other half topdressed, top-dressed urea).
- Nitrogen inputs on wheat (no urea, a low rate of pre-drilled urea, double the rate of pre-drilled urea).
- Gypsum on pulses (no gypsum, gypsum at 1 and 2.5 t/ha)
- Ascochyta control in lentils (no fungicide, fungicide at fifth node, fungicide at multiple timings during the season).
- P trials—plots established for 3 years (no P input, normal rate and double rate of P input).

## SOME POINTS ON FARM TRIAL MANAGEMENT

- ✓ It is always beneficial for a farm group to work together with extension staff or with local agribusiness. Agronomists can help in deciding on details such as soil sampling, monitoring, and interpretation of results. Farmers ensure practicality and realism.
- ✓ Locate the trial site well away from headlands, trees etc.
- ✓ Harvest area must be measured accurately.
- ✓ Always spray plots at right angles to the treatments (except in spray trials).
- ✓ Weigh bins are not essential. Some farmers have yield monitors installed on their header.



Farm inspections of on-farm trials are a great way for groups to learn about new developments in cropping (Birchip Cropping Group, Victoria)

**Further information**

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Agronomic consultant  
Technical Adviser to Birchip Cropping Group

## LESSONS FROM THE CONFLICTS OF A LONG-TERM DEMONSTRATION/ TRIAL

**Brendan Williams**

**GPS Ag**

**R. John Petheram**

**University of Melbourne**

### Introduction and broad description of the demonstration/trial

The project was instigated in 1991 by the Wimmera Conservation Farming Association (WCFA), a self-help group of 300–400 members, which aims to promote the adoption of conservation farming practices. They believed that it was necessary to demonstrate conservation cropping on a farm scale before the majority of farmers would accept the practicality or viability of the practices involved. WCFA sought collaboration to run the project on Longerenong College farm, with the rationale that:

- long-term measurements of crop performance and soil conditions were more readily recorded than on a private farm; and
- the site would have educational value for students and visitors.

Four rotational treatments were demonstrated, with two replicates (rotational phases) of each (Table 1).

The crops in the fallow rotations were cereal, pulse, cereal, fallow and those in the continuous cropping treatments were cereal, pulse, canola, pulse. Crop inputs and yields were recorded and measurements were made of soil variables, such as hydraulic conductivity, aggregate stability, organic carbon. Some data were collected on soil invertebrates, diseases, weeds, and soil nutrient levels. Not all data were collected each year.

### Objective

To demonstrate methods of conservation farming on a scale larger than had been previously used in tillage research—with a view to promoting conservation farming practices in the wider community. This tool has been farmer initiated.

### Tool type

- A long-term, paddock-scale trial, instigated by a large farmer group. Managed by an agricultural engineer and farm manager, working under a trial management committee of farmers. Monitored by a technician.

### Materials

- 40 ha paddock split into 8 x 5 ha plots—large enough to represent real farm conditions
- Normal farm machinery plus equipment for measuring change in soil condition
- Access to laboratory and soils testing

**Table 1.** The four rotations demonstrated over 10 years at Longerenong.

|                                        |        |                                                |         |
|----------------------------------------|--------|------------------------------------------------|---------|
| CULTIVATED FALLOW ROTATION             | Plot 1 | Conventional (cultivated) fallow rotation      | Phase 1 |
|                                        | Plot 2 | Conventional (cultivated) fallow rotation      | Phase 2 |
| CHEMICAL/ZERO TILL ROTATION            | Plot 3 | Chemical fallow & direct drill                 | Phase 1 |
|                                        | Plot 4 | Chemical fallow & direct drill                 | Phase 2 |
| CHEMICAL/ZERO TILL CONTINUOUS CROPPING | Plot 5 | Continuous cropping & chemicals & direct drill | Phase 1 |
|                                        | Plot 6 | Continuous cropping & chemicals & direct drill | Phase 2 |
| CULTIVATED CONTINUOUS CROPPING         | Plot 7 | Continuous cropping using cultivation          | Phase 1 |
|                                        | Plot 8 | Continuous cropping using cultivation          | Phase 2 |

The design of the trial did not allow direct comparisons between treatments within years, but any marked differences in costs or profitability or soil variables were expected to be detected over time. Numerous groups visited the site over the years, and the large scale plots have provided excellent material for student and specialist research projects.

The purpose in this article is not to report technical results, but to reflect on the lessons learned from running such a project with a large farmer group. However, Box 1 summarises some general results after seven years, as an indication of the some technical and financial output from the project.

**Box 1.** Some technical results of the demonstration/trial after seven years.

- no differences in yields or gross margins (GM) were demonstrated between the four cropping rotations/systems
- input costs were higher (\$30) for continuous cropping than fallow rotations
- average GM in continuous cropping (higher crop intensity and diversity) was depressed by higher incidence of poor or failed crops
- no significant differences in soil variables were detected between treatments
- organic carbon appeared to rise slightly under continuous cropping but not under fallow rotations (probably due to higher bulk of crop residues in the former)
- incidence of white snails was much higher under the conservation (stubble retention) systems

**Trial and tribulations**

The large-scale trial has been very beneficial to student and staff learning, and experience gained on the project has strongly influenced cropping practices on the college farm. However, this project generated considerable controversy. Some conflict arose through changes over the years in local farming issues, in WCFA committee membership, advisers and farm managers. When the technical or financial results did not clearly demonstrate the advantages of conservation farming practices, serious difficulties were experienced in retaining the interest of the sponsoring farmer group. Farm management was sometimes blamed for this 'failure' to meet expected results. And the farmer group were accused of not being open to results that conflicted with their main agenda, and for failing to seek funding for the trial. No-one was prepared to end the trial because:

- so much has been invested in it; and
- many believed the most important results are yet to be seen.

Some of this conflict could probably have been avoided by more concerted efforts to plan and communicate by the various parties.

### Lessons from the WCFA-Longerenong long-term trial

The Wimmera Conservation Farming Association is an active and innovative farmer self-help organization, and their intention and achievement in establishing this participatory project are commendable. The demonstration/trial involved their own members, college staff and farm, private consultants, and others. But for anyone considering similar long-term collaborative demonstrations projects with farmer groups, the design and conflicts that arose in this trial warrant careful consideration.

The term ‘demonstration’ should have given the first clue to a source of problems. The agenda of the farmer group from the start was that they had ‘technology’ that wanted to demonstrate—they believed strongly that demonstration would help to get these ideas adopted by the wider farming community. In their eyes, the measurements and records were to be made to support, rather than to test, their beliefs. So when the conservation tillage treatments did not show higher yields or profits than conventional treatments, there was a loss of interest by members of the farmer organisation, and some placed blame on the way the trial was run.

Those on-site managing the trial could be accused of acting too much on their own and sometimes making management decisions without reference to the farmer management committee. There was need for really strong rapport and understanding between the two groups, and for communication systems that allowed rapid discussion and decisions to be made. Rules for management decisions for each treatment were established, but these were not adequate to cope with all eventualities.

A third area of conflict came from funding difficulties. Long-term, large-scale trials are inherently expensive, even on college farms. When strong efforts were made to seek funding, various short-term sources were found in to be available in the industry. But these efforts were not always continued at the level needed and the consequences were a shortage of funds to carry out all the measurements and testing needed. Such demonstration trials need a special funding program and process to ensure that funding efforts are kept up throughout the life of the trial.



A visiting Landcare group discuss aspect of the WCFA/Longerenong long-term conservation farming demonstration/trial

#### LESSONS FOR ANYONE CONSIDERING LONG-TERM COLLABORATIVE TRIALS

- Beware of entering arrangements with groups that are very agenda-driven, or unwilling to change their views. Sometimes scientists can be very inflexible.

*...in this case, farmers got frustrated and lost interest when results did not follow their agenda.*

**Lesson 1. Ensure from the start that there is agreement on the aims, and real commitment to learn—from all parties involved.**

- Carefully manage the conflict that arises and the communication process between parties to the trial.
- ...in this case, conflict was not always well managed and groups lost faith and even blamed each other at times.*

**Lesson 2. Ensure that the facilitators are committed to high levels of participation, and skilled at managing conflict and enhancing communication between parties.**

**Lesson 3. Ensure that the project has adequate funding and a long term system for seeking funding and support from industry and other sources.**

## References

- Petheram R.J. and Williams B.W. 1998. Lessons from a long-term trial and its tribulations. In Norton, R.M. (ed.) Proceedings of Fourth Cropping Zone Conference. Institute for Sustainable Irrigated Agriculture, Tatura. 12–14.
- Williams B.W. 1994. Management issues in a long-term farmer collaborative trial. Proceedings of Tillage Workshop. CRC for Soil and Land Management, Adelaide, pp. 42–43.

## BIZCHECK ®

**Rod Luke**

**Rendell McGuckian, Agricultural & Management Consultants (1998)**

### Introduction

The BizCheck Program aims to:

- build a strategic rather than operational understanding of the business
- maximise learning for minimum effort on behalf of participant
- work with a large number of participants (to keep cost of delivery for benchmarking to a minimum)
- evaluate business performance and to help set priorities for further investigation
- make data collection as easy as possible
- build ongoing data collection that puts each years information in perspective
- promote simplicity (in some cases near enough is good enough to learn)

### Use of the tool

Farmer groups (average of 14 businesses per group) start with an introductory workshop to:

- explain the way in which figures are used to the key factors that influence disposable income per household;
- discuss how benchmarking is used in continuous improvement and making decisions;
- explain how to fill in the input form.

Farmers fill in input forms and meet with data input person to supply data and receive individual business benchmark report. A feedback workshop follows to discuss group results and provide group ranges.

### Introductory workshop session

1. Introduction: overview of sessions and learning outcomes.
2. Measuring business performance: how to measure business performance.
3. BizCheck principles: background, fit with continuous improvement, use of benchmarks.

### Objectives

To assist farmers to understand the strengths and weaknesses of the farm business.

### Other learning outcomes

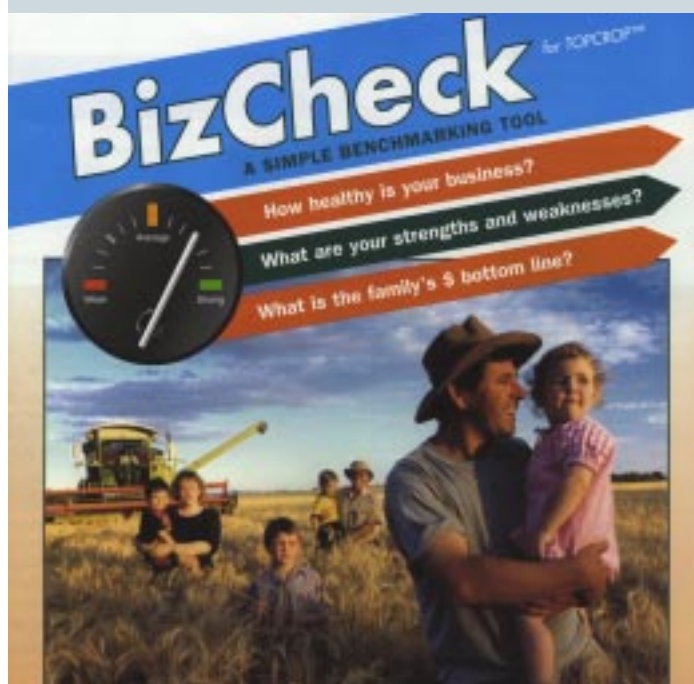
- Understanding the key factors that influence disposable income per household and net worth per household
- Understanding how benchmarking can be used to help make decisions
- Identification of strengths and weaknesses of business

### Tool type

- Group workshop, farmer data input, individual business benchmark reports. Feedback workshop to discuss group results and group ranges. BizCheck kit and Profit and Loss Statement (for grains, rice, durum grain, meat, wool, dairy, pork, citrus, grapevines, apples and pears).

### Materials

- Farmers' BizCheck kit, profit and loss statement from latest tax return
- Farm records



4. Disposable income per household: explains how key performance indicators are derived
5. Levels of benchmarking: examines differences between benchmarks at business and operational level.
6. Five farms: exercise for businesses to examine example data.
7. The input form: explanation of use.

#### Data input—one hour tutorial with data input person

1. Introduction and link to introductory session.
2. Group results—key performance indicators.
3. Your results: individuals identify strengths and weaknesses.
4. Key questions: what do the strengths and weaknesses mean for your business?
5. Conclusion, reflection and discussion.

#### BizCheck kits

The farmer kit for BizCheck consists of a summary of the notes covered in the workshop, an explanation of the performance indicators reported, key questions for business, and storage for the feedback sheets, individual and group results.

The input person's kit has the same information as the farmer kit with:

- . instructions for organising groups to collect data
- . examples of data
- . instructions on using the software
- . example reports

The facilitators kit has the same information as the input person kit with:

- . notes and overheads to complete the two workshops

#### **Additions needed to current instructions in booklet:**

- . evaluation sheet needs refining

#### Follow-up exercises

- . Multi-year reports are provided from year 3
- . Cost of production is available for some industries
- . Discussion groups and tours on specific performance indicators are available
- . BizCheck for Meat is part of Meat and Livestock Association's Prime Management program for meat producers

#### **Further information**

- . Rod Luke  
BizCheck Manager  
Rendell McGuckian, Agricultural & Management Consultants  
Box 2410, Mail Centre, Bendigo, Victoria 3554  
Phone: (03) 5441 4821; fax: (03) 5441 2788  
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## MARKETCHECK

**Brett Stevenson**

**AGeTraining a division of AGeBusiness Pty Ltd, Sydney**

**Registered Training Provider, University of New England Partnerships**

### Introduction

Many grain growers who have historically delivered grain into a national pool, now wish to expand their marketing environment. This may be a result of the Australian Wheat Board (AWB) becoming a commercial corporate enterprise (AWB Ltd) and/or the implications of a free to export market if the single desk export monopoly was disbanded. To meet the need for learning in this area, grain growers can enroll in an Introduction to Marketing for Grain Growers workshop. After attending this workshop the growers join a MarketCheck Group (i.e. a group of farmers wishing to market their grain more proficiently). This group will meet for at least the three seminars during the year.

Farmers can attend the one day workshop and then elect to join a MarketCheck group. The cost of attending the workshop is \$220 (GST included) per person. However, the program is supported by Farmbiz (a Federal and State government training initiative) and therefore depending on State of residence, the cost could be subsidized from between 50 to 90%. The MarketCheck groups have an annual enrolment cost of \$880 (GST included) per farm. This is also supported by Farmbiz and therefore the cost could be funded from 50–90%.

The program is coordinated by a number of regional accountants, farm management advisers, grain traders and farmers (see p. 122 for a list of current coordinators). People can join existing groups and attend an introductory workshop when it becomes available or can start their own group. If you wish to be contacted when a workshop is in your area or if a group is commencing in your area, interest may be registered on website <[www.agebusiness.com.au](http://www.agebusiness.com.au)> through the AGeTraining segment of the site.

### Objectives

Understand better the changes occurring to Australia's grain marketing structure.

Learn how Price Risk Management products such as Forward Contracts, Futures and Options work.

Learn how to apply these products to cropping and financial situations.

Learn how to develop a marketing philosophy or plan for farming businesses.

Learn how to keep up to date on market prices and developments.

Learn how to better market crops at harvest.

### Other learning outcomes

- Become more skilled at balancing price risk against production risk.

### Tool type

- The facilitators of this tool provide a combination of activities and services to ensure participation and learning over a one year period including:
  - a one day workshop
  - three seminars during the year: post-sowing, pre-harvest and post-harvest
  - weekly fax showing how the region's case study crop is being hedged
  - daily email on market prices and information

### Materials

- Workshop notes, weekly fax, individual marketing review, seminar notes. Available from:  
AGeBusiness  
PO Box R928, Royal Exchange, Sydney NSW 1225  
Telephone: (02) 9498 7323; fax: (02) 9498 1666  
Website: [agebusiness.com.au](http://agebusiness.com.au).

## **Process**

### Preliminary one day workshop

#### **Morning**

1. Changes to the Australian wheat market.
2. How forward contracts, futures and options work. Growers in the audience are encouraged to share their own experiences using forward contracts as points of discussion. We play the 'margin game' with a number of participants playing the role of a merchants and growers to demonstrate innovation and how margins are calculated.
3. How to apply the products to the crop during the season. Individual participants are asked to provide a crop forecast under set weather scenarios for different times of the year for discussion.

#### **Afternoon**

4. 'Price risk game': participants divide into groups of 3 or 4 and are required to manage the price risk of a crop during a synthetic season. Each group is given the same size farm in the area of the workshop. Groups are required to calculate their cost of production and provide a crop estimate. Futures and forward prices are provided and each group can start their price risk management strategy. The season is then varied over the cropping season and the futures prices are changed, requiring each group to update their strategy. At the end of the season the crop is harvested and the strategy finalised. Each group must provide their average return and this is then compared to the group. During the session participants are encouraged to question strategies and crop estimates of other farms.

### The MarketCheck program

Three MarketCheck sessions of 2–3 hours are conducted at critical times during the year. They are:

#### **1. Post-sowing (June/July)**

Update and discussion on developments in the wheat and canola markets both domestic and international. Explanation of hedging strategies used on the case study farm for the season to date. Participants question the strategy in regard to their own operation. Participants also ask questions about products they have been offered and how these may apply to their own situation.

#### **2. Pre-harvest (September/October)**

Update and discussion on developments in the wheat and canola markets both domestic and international. Participants question the strategy in regard to their own operation. Participants also ask questions about products they have been offered and how these may apply to their own situation.

This session includes a harvest marketing strategy discussion showing cost–benefit of available alternatives.

#### **3. Post-harvest (February/March)**

Update and discussion on developments in the wheat and canola market both domestic and international. Review of the case study farm, outcomes and lessons.

### Case study farm fax

A two page fax is sent to participants each Friday. It contains:

- updates on information and prices in the international and domestic market for wheat and canola
- updates by case study farmer in the region on how their wheat and canola crop is progressing
- schedule of hedging transactions made
- summary of action for the week and explanation why these actions were taken

### Daily email

An email message is sent to participants each morning detailing what has happened overnight in the international grain futures markets. Prices are all converted into Australian dollar values per tonne.

Samples and more information is available on the website  
[www.agebusiness.com.au](http://www.agebusiness.com.au)

### **MarketCheck: Wheat 1999. Comparison of performance of case study regions.**

| Region                   | Yield<br>(tonnes) | Increased \$/t<br>achieved when<br>compared to the<br>AWB pool<br>(\$) | Total (Yield x \$)<br>(\$) | Increased \$/t achieved<br>when compared to<br>the AWB muligrade<br>forward price<br>(\$) | Total (Yield x \$)<br>(\$) |
|--------------------------|-------------------|------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------|----------------------------|
| <b>New South Wales</b>   |                   |                                                                        |                            |                                                                                           |                            |
| Lake Cargelligo          | 2 432.75          | 12.87                                                                  | 31 321.16                  | 17.73                                                                                     | 43 137.37                  |
| Moree                    | 2 630             | 5.39                                                                   | 14 180.08                  | 8.98                                                                                      | 23 613.55                  |
| Wagga                    | 1 900             | 6.27                                                                   | 10 658.00                  | 11.41                                                                                     | 19 387.34                  |
| Temora                   | 1 334             | 10.51                                                                  | 19 799.94                  | 15.76                                                                                     | 29 690.94                  |
| Corowa                   | 2 360             | 13.93                                                                  | 32 883.50                  | 18.86                                                                                     | 44 520.74                  |
| Dubbo                    | 1 756             | 1.41                                                                   | 2 470.04                   | 6.37                                                                                      | 11 191.51                  |
| Forbes                   | 1 106             | 8.14                                                                   | 9 005.12                   | 12.66                                                                                     | 14 001.19                  |
| Gilgandra                | 743               | 3.52                                                                   | 2 616.00                   | 8.38                                                                                      | 6 224.86                   |
| <b>Queensland</b>        |                   |                                                                        |                            |                                                                                           |                            |
| Goondiwindi              | 4 351             | 2.72                                                                   | 11 855.00                  | 9.14                                                                                      | 39 773.92                  |
| Emerald                  | 621               | -2.63                                                                  | -1 631.40                  | 9.87                                                                                      | 6 131.10                   |
| <b>Western Australia</b> |                   |                                                                        |                            |                                                                                           |                            |
| Kukerin                  | 2 173             | 3.43                                                                   | 7 450.48                   | 8.02                                                                                      | 17 430.18                  |
| Dowerin                  | 4 754             | 1.77                                                                   | 8 400.48                   | 6.36                                                                                      | 30 233.67                  |
| York                     | 3 559             | 3.45                                                                   | 12 288.82                  | 8.10                                                                                      | 28 812.75                  |
| Narrogin                 | 1 915             | 5.18                                                                   | 9 918.96                   | 10.15                                                                                     | 19 430.13                  |
| Geraldton                | 2 806             | 4.23                                                                   | 11 874.65                  | 8.87                                                                                      | 24 902.51                  |

Disclaimer: The information provided has been prepared from information supplied by growers. It is provided as a guide only and does not have regard to the particular circumstances or needs of any specific person who may read it. This information is believed to be complete and accurate at the time of publication. MarketCheck does not accept any liability, whether direct or indirect, arising from the use of the information by any person.

## **MarketCheck case study farms in 1999**

A summary of results from the MarketCheck Price Risk Management for case study farms for each of the MarketCheck groups is listed below. There was a small negative return when Emerald was compared to the AWB pool, primarily due to that crop being only 30% of the expected harvest (i.e. it was a failure). Notice that in both wheat and canola, the returns generated are ahead of simply using forward contracts, which reinforces the benefits of being able to use the futures and option markets.

## **Existing MarketCheck groups and coordinators**

### Queensland

**Goondiwindi:** Matthew Meehan; CKR Agribusiness

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### New South Wales

**Moree:** Peter Talty; AgeBusiness

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**Gunnedah:** Tim Brett; Paul & Brett Services

Telephone: (02) 6742 0077; email: paulbrett@mpx.com.au

**Gilgandra:** Peter Woods; Gilgandra Marketing Co-op

Telephone: (02) 6747 1116; email: gmcl@lisp.com.au

**Dubbo:** Peter Carnell; Darcy Kennedy

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Email peter.carnell@darcykenedy.com.au

**Forbes:** Stuart Thomas; Todd & Brindley

Telephone: (02) 6852 1455; email: toddbrin@westserv.net.au

**Temora:** Terry Braban; BFB Grain

Telephone: (02) 6977 1177; email: terry@bfb.com.au

**Wagga:** Graeme Obst; Adams Keneally White

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**Corowa:** David Potts; Potts & Schnelle

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### Victoria

**Yarrawonga:** Kate O'Brien; BelAg

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**Horsham:** Nickie Berrisford; University of Ballarat Horsham

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**Charlton:** Nickie Berrisford; University of Ballarat Horsham

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### Western Australia

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Telephone: (08) 9964 5191; email: sfoley@mn.com.au

**Dowerin:** Lisa Featherby; Farmanco

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**York:** Rob Sands; Farmanco

Telephone: (08) 9641 2299

## GROWING THE FAMILY FARM BUSINESS

**Geoffrey G. Tually**  
**University of Melbourne**

### Introduction

Many farm family businesses are being placed at risk by focusing on how and when to hand on the family farm, rather than considering the options available for involving their children in the family business. The emphasis on inheritance is accompanied by a general lack of awareness about other options for growing the business within the family.

### Use of the tool

This tool is used as a workshop for students enrolled in the TAFE nationally accredited home study course: Rural Business Management (RBM) elective subject Estate Planning and Retirement. These are invariably farmers and partners or other mature rural people.

It is also run as stand-alone workshops for farm families seeking knowledge and understanding on options for involving children in the farm business. The workshops often arise from requests following presentation of a shorter seminar on Growing the Farm family Business to farmer groups.

The workshop revolves around six papers (see Table 1 for an example).

### Workshop process

#### Preparation

Materials need to be reviewed carefully by any intending facilitator to ensure a good understanding of the three different aspects of the family farm business (viz the family, legal ownership and business aspects) as well as how the aspects interrelate over time.

Determine number of participants in groups or families requiring the workshop. Obtain materials, suitable times and venue.

#### Workshop

1. Set up venue in a group setting around the overhead projector and daylight screen.
2. Hand out copies of *Putting the Family Back into the Family Farm*.
3. Draw participant attention to the copy of the manual *Rural Business and Modern Estate Planning* and encourage them to look at the manual during the workshop.

### Objectives

Enable farm families to work through the three major aspects of their farm family business, and options available for involving their children in the farm business or assisting them to develop their own business associated with their parents' farm business.

### Tool type

- A one-day workshop, or series of workshops, utilising a set of six papers (each of 4 pages) entitled *Putting the Family Back into the Family Farm*.

### Materials needed

- Suitable venue with chairs and comfortable writing tables
- Overhead projector and daylight screen
- Overhead slides
- Set of 6 papers: *Putting the Family Back into the Family Farm* (see Table 1)
- Developing your five-year farm business plans (optional use)
- Manual *Rural Business and Modern Estate Planning*
- Evaluation sheet for participant comment

4. Workshop introduction.  
Start by stressing to participants that family farms are BIG investments. The capital value of an average family farm is around \$1 million to \$1.5 million and there is a range of options available to the farm family to *grow* the farm family business, by building on the family's substantial investment. Participants usually comment that they have an idea of their farm's worth, but they have never been made to look at it in this way!  
  
Mention that the common approach of focusing on *inheritance* of the farm risks breaking up this large family asset and placing the child who *receives* the farm, in what could be an impossible financial position (especially where brothers and sisters have to be paid out their share of inheritance).
5. Introduce Paper 1 (see Table 1 for example of these supporting papers). An overhead slide on the relationship of family members to ownership of farm businesses (see Example Slide 1 below) is used to open discussion by group members, as most farm families have not seen their family farm this way before.
6. Use the six papers to provide *hands-on* participation by all members at the workshop. Members are encouraged to relate their own (or other family) relationships in the farm business. An example of part of a worksheet is shown in Figure 1. Present ownership plan (contained in Paper 6).
7. A second slide (on family goals) is used to generate discussion, by going over a number of example goals and asking for comment as to the applicability of each goal to their family situation.
8. Use slides from Paper 2 onwards or select (with the group) a preferred sequence of the papers for the remainder of the workshop.
9. Allow a working lunch of 30–45 minutes, during which informal talk continues with participants. This helps to identify an opener for after lunch on an issue of particular interest to the participants.
10. On completion of the six paper series, introduce the work book *Developing your five-year Farm Business Plans*, if it has been decided to include this in the workshop. These plans link the family, the financial and physical aspects of the family farm.
11. Hand out and collect the workshop evaluation questionnaire. Ask for general comment on need for follow-up and suggestions of how this might take place.

#### **Source of materials**

G.G.Tually

Longerenong College, The University of Melbourne

RMB 3000 Horsham, Victoria 3401

Telephone: (03) 5362 2255; fax: (03) 5362 2213

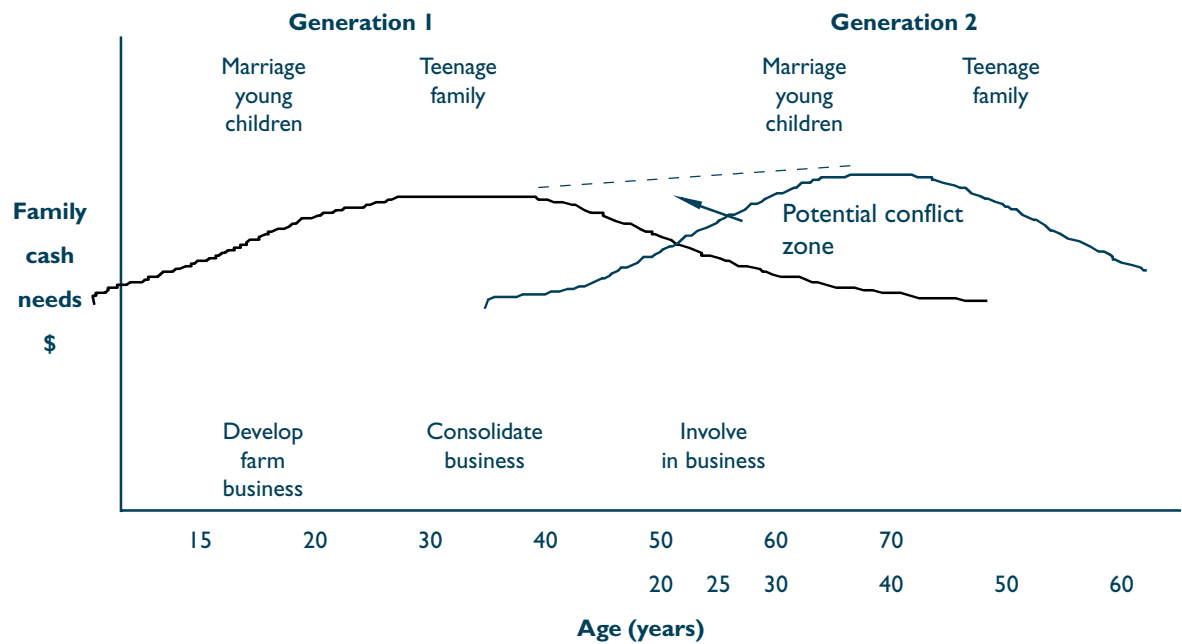
Email: g.tually@landfood.unimelb.edu.au

Samples of overhead slides

Slide 1. Relationship between the family, ownership structure and their farm.



Slide 3. Intergenerational involvement model (Manual, Section A, page 16)



Planning is about providing focus on how you propose to achieve your broad goals, through a series of shorter term (1–5 year) guide lines or specific plans. The previous 5 papers have focused on various aspects that need to be considered in developing the set of 3 separate plans for the farm family and their business.

- . Family plan content;
- . Ownership plan content;
- . Business plan content.

| Name (including wages where applicable) | per week | Present year | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|-----------------------------------------|----------|--------------|--------|--------|--------|--------|--------|
| 5                                       |          |              |        |        |        |        |        |

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

Total Cash Needs (children) \_\_\_\_\_

Total Cash Needs (parents) \_\_\_\_\_

|                  |    |    |    |    |    |    |
|------------------|----|----|----|----|----|----|
| Total Cash Needs | \$ | \$ | \$ | \$ | \$ | \$ |
|------------------|----|----|----|----|----|----|

Are there changes to family specific goals, following these estimates of cash needs for next five years?

enduring      0      \_\_\_\_\_      0

iii) Will contents (Paper 3) will directly relate to the Ownership Plan, i.e, whether land is held as joint tenants / tenants in common, in trust or company, life tenancy; shares / units held etc.

vi) Location of Wills \_\_\_\_\_

2. Ownership plans (suggested content) Review date \_\_\_\_\_

A) **Present ownership position** (different plan for each separately owned business/assets.)

i) Family farm business.

Ownership structure used.

|    | Business                   | Land (if separate ownership) |                       |
|----|----------------------------|------------------------------|-----------------------|
| a) | single proprietorship      | <input type="radio"/>        | <input type="radio"/> |
| b) | partnership: joint tenancy | <input type="radio"/>        | <input type="radio"/> |
|    | tenancy in common          | <input type="radio"/>        | <input type="radio"/> |
| c) | trust discretionary        | <input type="radio"/>        | <input type="radio"/> |
|    | fixed (%____)              | <input type="radio"/>        | <input type="radio"/> |
|    | unit (unit price \$____)   | <input type="radio"/>        | <input type="radio"/> |
| d) | company                    |                              |                       |
|    | Includes family home       | <input type="radio"/>        | <input type="radio"/> |
|    | Family home separate       | <input type="radio"/>        | <input type="radio"/> |
|    | Authorised capital         | \$_____                      | \$_____               |
|    | Issued capital             | \$_____                      | \$_____               |
|    | Per value of share         | \$_____                      | \$_____               |

Different classes of shares \_\_\_\_\_

ii) Where land held separately, what is the relationship of the land to the business?

iii) Title deed(s) where located \_\_\_\_\_

iv) Life tenancy involved. Yes ☐ No ☐. If yes, what effect on ability to change the ownership structure of the business \_\_\_\_\_

v) Off farm investments owned within this farm business ownership structure

B) **Future membership of presently used ownership structure, if changes are to be made.**

i) Reasons for change, e.g., allow for growth, recognise off farm income used by farm business, provide children experience. \_\_\_\_\_

ii) Who is to be added and how involved.

| Member | Share (or unit) gifted | Share (or unit) purchased. |
|--------|------------------------|----------------------------|
|        | No. or %               | No. or % price.            |

iii) The new ownership position

| Member | Share No. or % | Value |
|--------|----------------|-------|
| _____  | _____          | _____ |

iv) Any capital gains effect of membership change.

**C) Change to a different ownership structure.**

i) Before changing to a different ownership structure write down reasons for change.

What present structure cannot do, what the new structure can do, i.e. What advantages you seek.

---

What are the disadvantages of a change \_\_\_\_\_

New ownership structure chosen

---

ii) The new ownership position

a) business

| member | share No. or % | value |
|--------|----------------|-------|
| _____  | _____          | _____ |

b) land (if separate to business)

| member | share No. or % | value |
|--------|----------------|-------|
| _____  | _____          | _____ |

---

c) effect of capital gains tax on change in ownership structure.

d) stamp duty involved

**Note:** May be better to form new ownership structure for a new business venture, rather than change ownership structure of present business.

## THE SEEK — FAMILY SKILLS AUDIT

**Mike Stevens**

**Mike Stephens and Associates Pty Ltd**

**Nigel McGuckian**

**Rendell McGuckian Agricultural Consultants**

### Introduction

To live we need skills. To be a useful family member or community member you need skills. To run a farming business farmers and families need skills. Farmer groups need skills if they are to be effective in achieving community or group goals.

Skills audits have been used in recent years to identify the skills essential to an industry. Audits are conducted on businesses in the industry, to determine how the skills already held by people operating and working in the business match those needed for success in that industry.

Most people in farming have many skills but do not necessarily have the skills required to run a successful farm business. The SEEK kit is a resource designed for use by individual farmers, farm families or partnerships. It is used to identify the skills that members are already using and the skills required to run a more efficient and productive business, that may need to be improved. It may also be used by community groups, with minor modifications to the 'game' and process.

### The kit

- A place mat, which is rather like a game board (see Figure 1).
- Instruction booklet
- Nine (different coloured) sets of cards—one for each of the topic areas:
  - Production management
  - Human resource management
  - Stock husbandry
  - Financial management
  - Resource management
  - Dairy management
  - Marketing management
  - Intensive animal production

### Objectives

To enable families or other groups (or individuals) to determine the skills they are already using, and skills that they need to develop to run a more efficient business, and to improve their lifestyle.

To identify courses or contacts that will allow participants to obtain new skills or skills that need improvement.

To identify skills that are held, but which are not fully utilised on the farm.

To examine ways of exploiting skills available, outside the farming business.

### Tool type

- The activity utilises SEEK—or the Skills, Evaluation, Education Kit—which is used in a workshop. May be run by a facilitator, or by the group following the instruction booklet, over 2–3 hours. Formulating a thorough action plan may require more time or another session.

### Source

- Rural Finance Commission of Victoria  
325 Collins St, Melbourne  
Victoria 3000

## **The SEEK process: using the SEEK kit**

### 'Playing the game'

The aim of the activity is explained and the kit is placed on a table around which the group is seated in comfortable chairs.

First, the group decides which topic areas are relevant to their situation, and therefore which sets of cards are required, and which can be put aside.

Work through one set of coloured cards at a time, reading out the skill on each card and then placing it on the appropriate square of the board. To do this, for each card:

- . first answer the question, 'for this skill, are we very good, just good, or pretty ordinary?'
- . next answer the question, 'in our business, is this skill essential (often needed), or sometimes useful, or rarely needed?'
- . look at the information on the back of each card, to fully understand the skill.

Depending on the diversity of the group, the placing of certain skill cards may require a lot of discussion. The view of other members on the levels of skills held by the group can be very revealing and may even cause conflict.

After all the cards have been sorted onto the place mat, the placings will provide an evaluation of the skills, which can then be analysed.

### Analysis of results

First focus on the most important squares on the board:

- . Skills in the top left hand corner are the essential ones that you can improve.
- . Skills in the bottom right hand corner are those that you have but are rarely needed on the farm, but may be able to exploit somewhere.

Then look at the distribution of colour of cards on the board:

- . Is there any trend?

The colour of cards which are predominant in the 'improve' box will indicate the improve box will give a broad idea of the main skills area in which you or the 'team' need to improve. If those cards are grey in colour, then you will know that you need to improve your financial skills.

- . Is the range of skills in the 'exploit' square narrow or broad.

If the cards in the exploit square are mainly one colour, this may indicate that the group needs need to broaden their skills in other areas.

### Formulating an action plan to meet skill needs

Focus on skills that can be 'improved' and 'exploited'.

First determine the discipline area (colour) that has the most cards in the 'improve' square.

Now make an action plan:

- . set goals for improvement
- . set strategies to achieve the goals

Goals should be *specific, measurable, agreed, realistic* and *time-constrained*.

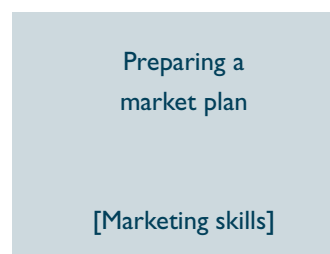
Example of goal setting (for one member):

- 'By the end of the year I will have improved my negotiating skills so I am confident to deal with the annual review at the bank'.

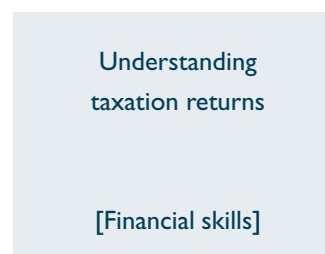
Example of a strategy (for one member):

- Brochures will be obtained from all training providers.
- All lists of courses will be studied.

| At this skill I am relatively .... |                |      |                |
|------------------------------------|----------------|------|----------------|
|                                    | ORDINARY       | GOOD | VERY GOOD      |
| ESSENTIAL<br>OR OFTEN<br>NEEDED    | <i>Improve</i> |      |                |
| USEFUL OR<br>SOMETIMES<br>NEEDED   |                |      |                |
| UNIMPORTANT<br>OR RARELY<br>NEEDED |                |      | <i>Exploit</i> |



Example of a pink card



Example of a grey card

**Figure 1.** The SEEK board/mat (about one third actual size).

**Note:** On the back of each card is a list of specific skills related to the skill area.

- . All courses on negotiation will be noted and contacts made..
- . I will chose and enrol in a suitable course.
- . I will undertake a successful annual review of accounts with bank manager in November.

**Further information**

- . Mike Stephens  
Mike Stephens and Associates, Pty Ltd  
Telephone: (03) 5341 7652
- . Nigel McGuckian  
Rendell McGuckian Agricultural Consultants  
Telephone: (03) 5441 4821

**Copies of the SEEK kit can be obtained from**

- . The Rural Finance Corporation  
325 Collins St  
Melbourne, Victoria 3000

## COMMUNICATING PROBABILITIES TO FARMERS: PIECHARTS AND CHOCOLATE WHEELS

**Peter Hayman**  
**NSW Agriculture**

### Introduction

The National Drought Policy Review Task Force stated that *management decisions should take into account the law of probabilities*. This is easier to say than do. Although farming has always been a risky business and gambling a national past time, explaining probabilistic forecasts represents a major communication challenge.

For example, based on the southern oscillation index (SOI) rising late in autumn, we can say that the probability distribution of winter rainfall is significantly wetter than the long-term record. However, we cannot say that it will definitely be a wet year. The essence of the problem is that climate science forecasts shift in distributions while farmers and agronomists sample single seasons.

### Current approaches

One way of communicating probabilities to farmers has been to tap into the gambling psyche of Australians and use the analogy of horse racing. We have found that this does not always work:

- . there is a significant minority who have an aversion to gambling;
- . for the majority who have an occasional flutter, there is not much rational weighing of probabilities on the race course (the exception, of course, is the bookmakers);

Another problem with the horse racing analogy is that it emphasises the notion of a tip which comes from inside knowledge and is either right or wrong. Bernstein (1996) was critical of the association between risk and fate or luck *If everything is a matter of luck, risk management is a meaningless exercise. Invoking luck obscures the truth, because it separates an event from its cause.*

Most climate risk information in decision support systems (DSS) has relied on cumulative probability functions (in some cases falling, in other cases rising) tables or less commonly, frequency distributions. One of the more popular ways of presenting risk information is box plots, which convey a strong visual impact of risk (see Figure 2 example of box plot from Australian Rainman).

### Objectives

To engage farmers and advisers in a dialogue about climate variability in their region.

To communicate the nature of uncertainty in seasonal climate forecasting.

To help farmers and advisers understand probabilistic forecasts.

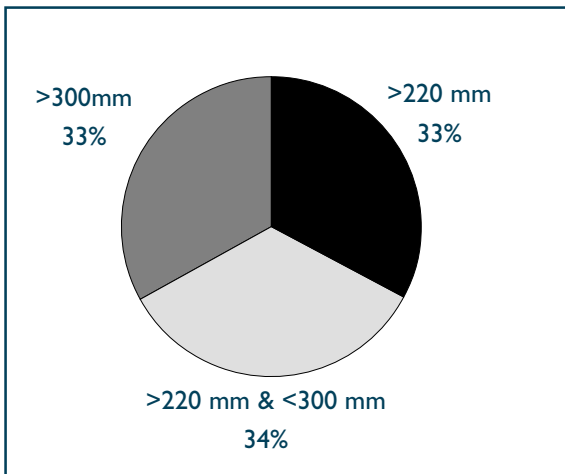


### The chocolate wheel as a visual presentation

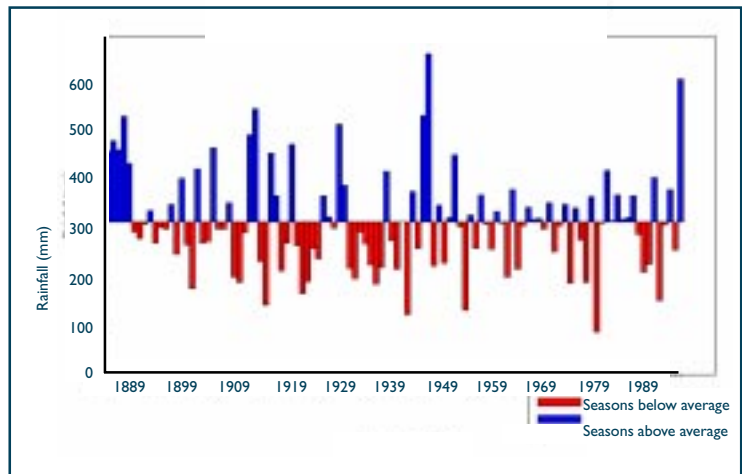
The field of operations research and decision analysis has a long history of using probability information. Generally, visualisation approaches have been shown to be superior to direct use of probabilities when dealing with non mathematicians. The two more common visualisation approaches are assigning counters and the probability wheel.

In our Grains Research and Development Corporation (GRDC) project on climate risk with farmers in northern NSW we have found that a useful alternative is the chocolate wheel. A wheel with say 100 nails is spun, and a prize (chocolates?) is given depending where the pointer ends up. The chance of a good outcome is dependant on the pattern of the pie chart of the chocolate wheel.

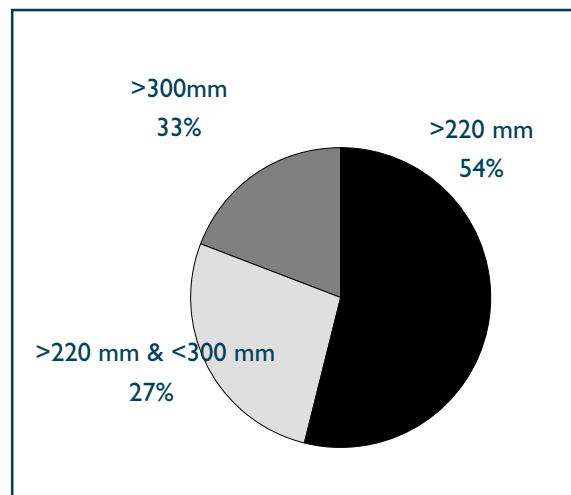
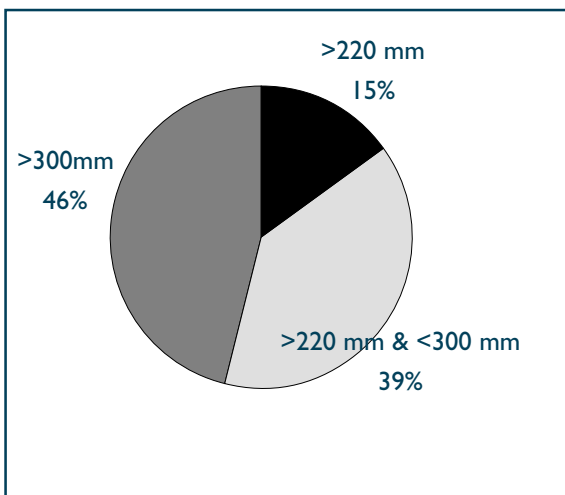
We present growers with a pie chart divided into thirds, based on the long term record. Growers are presented with a scenario in which they are told



**Figure 1.** Terciles (thirds) of June to November rainfall at Tamworth.



**Figure 2.** Time series of Tamworth (June to November) rainfall from the software package Australian Rainman.



**Figures 3 and 4.** June to November rainfall at Tamworth as influenced by the movement of the SOI in autumn.

they have an equal chance of a poor (< 220 mm), average (220 to 300 mm) or good (> 300 mm) season over winter. Our best results have been when we have taken the time to enter a number of individuals' estimates on a white board of the different amounts of rainfall in the poorest one third of years and the best one third of years (Figure 1). We then distributed a time series of winter rainfall which generated discussion about recent and past events (Figure 2.)

When the growers have agreed with the values on the chocolate wheel, the wheel is spun—to reinforce the notion that there is an equal chance of landing in one of the three seasons.

The SOI phases are then used to show how the pattern changes under a rising or falling SOI (Figures 3 and 4). The point is reinforced that the chance of a good season > 300 mm rises from 33% to 46% when the April/May SOI is rising but that there is still a 15% chance of a poor season.

This chocolate wheel should be seen as part of a whole toolkit. A colleague from Queensland commented that farmers preferred the pie charts, advisers preferred the box plots, and scientists and economists the cumulative density functions.

No doubt some farmers will prefer cumulative density functions, and some will 'progress' from pie charts to the cumulative density function. However, given that the complexity in farming lies in making the decisions work rather than finetuning probability distributions, knowing the chance of a below average, average or above average season will often be the most appropriate level of resolution.

The latest version of Australian Rainman (v 3.3) has incorporated the pie charts and we are in the process of developing a decision tree approach that uses the pie charts. In our experience it is best to have a working model of a wheel that spins and then use overheads or computer projections of the changes of the pie charts. In some workshops we involve farmers in an investment (as opposed to gambling) exercise using the spun wheel.

This work is part of a project on decision support for dryland crop production conducted by NSW Agriculture and the University of Western Sydney, Hawkesbury and funded by the Grains Research Development Corporation.

#### **SOME ADVANTAGES OF THE CHOCOLATE (PROBABILITY) WHEEL**

- ✓ The broad categories of good, average, and poor seasons are a useful place to start a discussion of risk. When a box plot or cumulative probability graph shows the extreme events these are the most noticeable and tend to dominate the discussion.
- ✓ By first looking at the climate variability for all years it gives some indication of the spread of background variability of the rainfall in the region.
- ✓ The notion that the SOI is changing the pattern on the chocolate wheel (while the farmer only has one spin of the wheel) conveys the need for a safety first approach to risk, as opposed to a situation where there are multiple spins of the wheel.
- ✓ The chocolate wheel communicates the difference between a probability based forecast and predicting a future event.
- ✓ The chocolate wheel is easy to use and allows comparison of different sources of probability information. For example, a statistical approach from Australian Rainman, the seasonal climate forecast from the Bureau of Meteorology or the subjective probability distribution of a farmer.
- ✓ We have used a water use efficiency calculation to convert from rainfall to wheat yields. In northern New South Wales, this has enabled us to convey the idea of the SOI and stored soil water.

**Further information**

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## RISKY BUSINESS

**Vanessa Stewart and Ross Kingwell,**  
**Agriculture Western Australia**

### Tool developers

Amir Abadi, Ross Kingwell, David Pannell and Vanessa Stewart  
Cooperative Research Centre for Legumes in Mediterranean Agriculture,  
University of Western Australia and Agriculture Western Australia

### Use of the tool

This workshop has been delivered in Queensland, New South Wales, Victoria, South Australia and Western Australia. Past participants have included agronomists, agribusiness consultants, bank managers, financial advisers, extension staff, research personnel, farmers and students.

This hands-on interactive event provides participants with the opportunity to become a farmer for a day. Each participant makes decisions constrained only by the normal constraints farmers face:

- . financial limits;
- . land capability limitations;
- . enterprise limitations and interactions; and
- . price and seasonal variability.

Each participant is faced with the challenge of choosing to adopt an innovation into their farm's cropping program, making off-farm investments or purchasing new land. Participants experience this by playing a simulation game.

Short talks complement the game and cover topics such as price and climatic variability, land degradation and the principles of adoption.

Participants compete against one another and yet also collaborate with one another during the day.

A number of versions of Risky Business have been developed based on these concepts. One of the variations is known as Salty Business where the challenge is encroaching salinity and participants must make decisions on whether to plant trees, when and how many.

Much of the success of the workshop has been achieved because participants are learning by doing. Each of the 'game masters' who present the workshop are dynamic with particular talents in encouraging discussion and relating participants' experiences back to real life farming systems.

### Objectives

To increase understanding of the:

- . decision making processes involved with assessing an innovation for adoption
- . importance of risk and uncertainty in farm management

### Learning outcomes

- . Better appreciation of the impact of climatic and price variability upon farm management
- . Better understanding of the difficulty of assessing the potential of new innovations and therefore the apparent hesitancy of farmers to adopt them
- . Understanding of the complexity of the environment that farmers work in

### Tool type

- . Workshop revolving around the use of a bio-economic simulation model
- Delivery of Risky Business is restricted to trained licence holders.

### Materials required

- . Computers with Excel, whiteboard or butchers paper, software

### Workshop process

The workshop involves participants completing 'farm plans' by basing decisions on forecast seasonal and price conditions. This is representative of how farmers have to make decisions on their cropping programs with very limited information on how the season will unfold. Once each plan has been completed it is entered in the computer. Results are revealed after the last participant has entered his or her plan. Everyone then uses the outcomes of these results and further forecasts of prices and weather to devise a plan for the next season. If a succession of 'poor' seasons occurs participants may find that they are constrained in their ability to respond and operate as they would prefer, due to financial constraints.

The workshop operates with a competitive air as each 'farmer' tries to do better than their 'neighbour'. There is much opportunity for discussion on issues such as how an apparent good or sound decision can actually end up being the wrong decision in some conditions.

During the course of the game, participants are given the option to adopt a new innovation. In Risky Business it is the option to consider a new grain legume crop for heavier soils, while in the Salty Business version it is the option to decide when and how many trees to plant. This creates the opportunity to discuss the factors that influence the adoption of innovations and approaches that farmers take to trialling innovations. It highlights the opportunity cost associated with different options.

### Feedback

Participants to all workshops provide written feedback on their experiences (Figure 1). During the course of the workshop participants' emotions become greatly involved as the results of their farm plans are returned to them at the end of each season. For example results from favourable seasons create an atmosphere of excitement in the room while a succession of poor years leads to quietness and frustration at the inability to modify outcomes.

Participants frequently comment on how much they enjoy the learning environment that is created in the workshop. They enjoy the fact that they are 'learning by doing'.



Those who participate in the workshop who are not from a farming background frequently comment on how much it has increased their understanding of the complex environment in which farmers make their management decisions.

Participants in a Risky Business workshop

**Risky Business workshop participant feedback sheet (on tree-planting for a farm affected by salt)**

Name:

Your Occupation:

*To help us improve our future events please fill in this survey and hand it in before leaving. Please circle or tick the appropriate boxes. Thanks,*

Workshop Development Team.

1. How would you rate the relevance of the workshop to issues you and your clients deal with?

Irrelevant      Unsure      Relevant

Who are your clients?.....

2. Do you think your skills and knowledge have been enhanced by attending the workshop?

No              Some              Considerably

3. How would you rate the performance of the presenters?

Poor    Average      Good    Exceptional

Where could the presenters improve?

.....

.....

.....

4. What level of emphasis do you feel should be placed on the following aspects of the workshop?

Less              Same              More

Lecture on sources of risk

Introduction to playing the game

Farm games

End of year discussions

Final discussion

5. Please rate the following aspects of the event and its facilities:

Poor              Average              Good

Food

Lighting

Visuals

Audibility

No. of breaks

Seating

Prizes

6. What are the best months of the year for a one day event like this?

.....

7. Which other groups within or outside agriculture might benefit from participating in the workshop?

What modifications would be required for that group?

.....

8. How well do you think that the game conveyed the following concepts?
- i) The profitability of trees is a key issue for farmers.  
       Not at all      Not well      Well
- ii) Planting trees restricts future farm decision-making flexibility.  
       Not at all      Not well      Well
- iii) It is crucial for farmers to know whether their salinity problem is on-farm or catchment-based.  
       Not at all      Not well      Well
- iv) Uncertainty has a major affect on farm decisions.  
       Not at all      Not well      Well
- v) The opportunity cost of planting trees is high.  
       Not at all      Not well      Well
9. What were the two most annoying parts of the workshop for you?
- i).....
- ii).....
10. What were the top two highlights of the workshop for you?
- i).....
- ii).....
- 11-What were the two most important points you learnt today?
- i).....
- ii).....
12. Can we refer to your comments in future promotions of this workshop?      Yes  
       No
13. What improvements should we make to the workshop?
- .....
- .....

*Thank you for completing this survey.*

## References

- Marsh S.P. 1999. Salty Business: A game to illustrate concepts about managing risk in a salt-affected farmland catchment, SEA Working Paper 99/10, Agricultural and Resource Economics, The University of Western Australia. Further information can be found at <http://www.general.uwa.edu.au/u/dpannell/dpap9910.htm>
- StewartV., Marsh S., Kingwell R., Pannell D., Abadi A. and Schilizzi, S. (submitted) Fun and games in farming systems education?: a case study. *Journal of Agricultural Education and Extension*.

## Further information

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## FARMSCAPE – FOR IMPROVED MANAGEMENT OF PRODUCTION RISK

**Zvi Hochman, Peter Carberry, Bob McCown, Dean Hargreaves, Mike Foale**  
CSIRO Tropical Agriculture

### Introduction

Dryland farmers operating on the heavy-textured soils of sub-tropical north-eastern Australia are dealing with the highest level of climatic risk and uncertainty of any farming zone in Australia. Crop production is largely confined to soils which possess a large capacity to store water, which compensates for the low probability of adequate in-season rainfall to produce a worthwhile crop. Decision making by farmers in this uncertain environment relies heavily on accumulated experience. Valuable assistance may be provided by improved information about past seasonal rainfall, and about the specific soil properties of a production unit on-farm, as well as the field adaptation and field performance of the chosen crop and variety. It is against this background that researchers developed FARMSCAPE (Farmers Advisers and Researchers Monitoring Simulation Communication And Performance Evaluation) as a research approach which drew together the experience of farmers and the skills and tools of research in a unique way.

### How the tools are used

#### Soil coring and weather records

The soil tools consist of a coring outfit used to sample cores that enable definition of the crop root-zone, and definition of the upper and lower limits of plant available water. The state of soil water and available nitrogen prior to crop growth are both essential inputs to a simulation run. The weather (daily rainfall, temperature and solar radiation) is monitored using an automatic weather station. Simulation is carried out with the APSIM model (Agricultural Production Systems Simulator) which performs daily calculations of soil water and nitrogen, and crop growth and development.

Long-term weather records for selected locations have been placed in a database for access by the simulator. Records extend for more than 100 years in many cases and can readily be retrieved for any chosen year or group of years. There is

### Objectives

To facilitate joint learning by farmers, advisers and researchers about the performance and characteristics of individual farming systems using the technologies of soil and weather monitoring combined with computer-based crop simulation.

### Other learning outcomes

- An enhanced understanding of farming systems (e.g. moving from an understanding based on 'depth of wet soil' to that of 'plant available water capacity', the total amount of water available to a crop).

### Tool type

- The FARMSCAPE activity employs a number of tools and integrated resources, in work with farmers and their advisers, individually and in group workshops or on the internet:
  1. physical resources such as tools for monitoring the soil and the weather, and for performing computer simulations,
  2. information resources such as historical weather records and computer data-bases and software for simulation of crop production,
  3. procedural rules that govern the process of joint field activity, communication between participants at each stage of activity.



FARMSCAPE activity around the kitchen table

also a database known as APSoil, made up of information on a range of soil types. This information includes the upper and lower limit of plant available water, layer by layer for the root zone appropriate to particular crops, as well as values for organic carbon, and physical variables related to infiltration rate. The simulation software comprises almost 30 modules, each for a different crop, and an 'engine' which integrates the soil, crop physiology, crop management and climate inputs to generate a daily output.

A FARMSCAPE activity begins with negotiation with a farmer and their agronomic service-provider to conduct an on-farm participative experiment, followed by discussion of the outcome and the use of simulation to add further value to the information. Depending on the level of confidence generated in the group at this stage, further communication activities may be undertaken and the use of simulation extended to assist in decision-making for future crop management.

### APSIM

Central to this approach is the use of computer-based crop simulation. The Agricultural Production Systems Simulator (APSIM) is used as part of discussions between farmers, their advisers and researchers about management and production issues. Simulation allows farmers to investigate the consequences for a range of 'what if' questions, over time periods and on a scale that would be uneconomical in real farming practice.

### What-If analysis and discussion (WifAD)

A WifAD is the centerpiece of the FARMSCAPE approach. It is the process whereby farmers, their advisers and researchers together discuss management and production issues with the aid of the APSIM simulator. This is often undertaken around a farmer's kitchen table, but is now frequently conducted remotely via the internet. This results in reduced cost and increased timelines.

The following four applications of APSIM are outlined, as identified jointly with farmer collaborators.

### APSIM benchmarking

Whereas farmers are generally polite about the use of models by researchers, they are unable to develop confidence in a model unless it can be shown to provide a sensible simulation of the performance of a crop in their paddock. Farmers are very aware that there are important differences between paddocks, even within a farm let alone in a district. They often comment 'it would not work on my place' when shown results from a simulation done on another paddock, yet they will accept readily the use of simulation after it has worked well on their own or a neighbour's crop that is well known to them.

Successful benchmarking requires good quality characterisation of the soil in the test paddock for upper and lower limits of plant available water. The soil must also be monitored prior to planting for water and mineral nitrogen, and organic carbon percentage. Daily weather records for rainfall, temperature and solar radiation are essential inputs to the model.

At crop maturity, farmers harvest their experimental strips (quite often different treatments have been applied (e.g. nitrogen fertiliser) and compare

yield with the output of the simulator. Where farmer confidence in APSIM is still developing, the question of how well APSIM performed against the actual crop performance is addressed. Where such confidence has matured, then attention turns to benchmarking how the crop compared to the simulated yield potential. Either way, explanations for low or high discrepancies between actual and simulated performance form the basis of discussion and learning by farmers, advisers and researchers.

#### Production decision support

Analysis of how a particular management action influenced yield in a previous season triggered farmers' interest in whether such hindsight could be turned into foresight. Could simulation be used in planning for the current or upcoming crop? Based on knowledge of pre-plant soil water, soil nutrient status, and the seasonal climate outlook, can simulation be used to forecast the likely outcomes of decisions on crop choice, variety selection, fertiliser rate, sowing date, plant population, or row configuration? Based on pre-plant soil monitoring data, simulation enabled assessment of expected crop performance in the upcoming season by calculating what would have happened with the same 'starting conditions' in past years for which rainfall records exist. Additional skill was added to such forecasts by using the Southern Oscillation Index (SOI) phase system as an indicator of climatic outlook.

This type of WifAD tended to stimulate farmers to develop new heuristics for action. An example describing how a new rule for sowing time of sorghum in a negative SOI phase emerged from a farmer's intuitive hunch that was confirmed by simulation at such a WifAD session (and subsequently by experience) is provided by Hochman et al. (1998).

#### APSIM—marketing decision support

While it is important to grow a good crop, it is just as important to sell it for the best price. Farmers have identified advantage in using APSIM for the purposes of marketing decision support. In the case of sorghum, for example, between July 1998 and January 1999, the price at the farm gate fell from A\$150/t to A\$100/t. Growers who were confident of a good season could have taken out a contract early on to capture the high prices. Reducing uncertainty about yield adds to the producer's ability to hedge against fluctuation of income. The farmer who initiated this activity thought APSIM could be a useful tool to help give an indication of potential yield. Using a paddock-specific data, it is possible to run the APSIM simulator to forecast the probabilities of achieving various yields in any paddock for which there are sufficient data.

#### APSIM—system design (analysis of management change)

Farmers on the Darling Downs use APSIM to compare their crop rotations and to include in the analysis some other rotations that they had been considering. It is worth noting that this was not a request to find the 'optimal' rotation. It was a request to compare a limited number of rotations that were already considered by the farmers and their advisers to be desirable on a number of grounds, including reduced



Extracting soil cores for moisture measurements on monitored paddocks

dependence on chemicals for the management of soil-borne diseases and weed control—phenomena not dealt with by APSIM.

Cooperative learning took place through a number of iterations. At the initial meeting contending rotations were selected and farmers' management rules for each rotation were agreed upon. Researchers then set up and ran the simulations and prepared spreadsheets for presenting results. In the next meeting costs and prices for gross margin analysis were agreed on and results presented and discussed. With some groups this led to another round in which refined variations of one or more rotations were simulated and reported. While the main focus of the groups was on average income per hectare per year, other issues, such as organic matter rundown and soil loss were also of interest, opening the door for future exploration of resource conservation issues.

#### **Available from**

- . Agricultural Production Systems Research Unit  
Toowoomba, Queensland 4350  
Email: farmscape@tag.csiro.au  
Website: [www.farmscape.tag.csiro.au](http://www.farmscape.tag.csiro.au)

#### **References**

- Hochman Z., Coutts J., Carberry P.S. and McCown, R.L. 2000. The FARMSCAPE Experience -Simulations Aid Participative Learning in Risky Farming Systems in Australia. In. Learning and Knowing Processes for Change in Agriculture in Industrialised Countries. (B Hubert and R Ison eds.) INRA Versailles (in press).

## INTRODUCING LANGUAGE AND CONCEPTS OF CLIMATE (FOR RAINMAN)

**Peter Thompson, Allyson Williams**

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### Introduction

Computer software products such as RAINMAN have been developed to assist farmers in understanding and using seasonal climatic data, which is specific to their area, and thereby help develop less risky and more profitable management programs. However, the language and statistical terminology used in climate forecasting is often confusing to farmers and other potential users. This workshop is designed to introduce participants to important terminology and concepts before they take part in the more advanced section of the workshop on the RAINMAN software. It utilises some home-made equipment and data handling exercises that have been found useful as participatory learning aids.

The aids are used to break up a two hour presentation into short, participatory and 'audience-friendly' segments. Each segment/aid takes between 10 and 30 minutes. The tools assist participants to understand the climate system, climate forecasting, probabilities, and forecasting jargon.

### Workshop process

Workshops commence with an introduction to climate forecasting and lead on to a detailed explanation of the term Southern Oscillation Index (SOI) using overhead projector slides and examples of recent data and trends. Participants are then asked to complete an exercise using pre-printed pages from a customised Excel spreadsheet. Filling in the worksheets helps participants gain understanding of the SOI phases and values, and the monthly variation in these.

Participants are provided with a customised Excel spreadsheet of SOI data, as well as rainfall and streamflow data, from the rainfall and river gauging stations closest to their property (Table 1). They are asked to select a year of interest to them and to transfer the rainfall, streamflow and SOI data for that year onto a pre-printed blank worksheet.

### Objectives

Enhance understanding of the concepts and relevance of seasonal climate forecasting, as well as the effects of rainfall on streamflow.

Remove the mystery from common statistical terms used in seasonal climate forecasting.

Improve awareness of the extent and nature of changes in SOI during the year.

Prepare farmers for using RAINMAN software for their own area.

### Type of tool

- Workshops are held prior to introducing groups to RAINMAN software, using the four 'tools' listed under 'materials' below, as aids to participation and learning.

### Materials

- Data Litepro projector
- Computer(s) to run Excel spreadsheet
- Ten (selected) heads of wheat (or any cereal or grass)
- In addition, the following aids to participation are used:
  - customised spreadsheet which is modified for each workshop
  - dynamic model of the Walker Circulation (vacuum cleaner and flashing lights)
  - participative exercise on statistical terminology, using participant's heights
  - participative exercise on probability, using 10 heads of wheat

At the completion of this exercise, the facilitators are able to use the computer and data projector to project the results of each participant's analysis onto a screen. Because the spreadsheet graphically presents the results for each scenario as well, participants see their selected year's results graphed. Where possible, this information is also printed for each participant.

Table 1 Example of spreadsheet format.

This exercise was designed to cover 15 months, in keeping with the autumn to autumn phase locking nature of the SOI.

#### A dynamic Walter Circulation model

This is a physical, dynamical model that simulates the changes in the Normal, El Niño and La Niña states of the equatorial Pacific Ocean and atmosphere. The demonstration encapsulates the changes in sea surface temperatures, the air currents and circulation as well as changes in the sub-surface thermocline.

The atmospheric component of the model is driven by air flow from a vacuum cleaner and flashing blue, red and orange lights, which represent ocean temperatures. While a similar graphic presentation is available in a Powerpoint display, the three dimensional nature and novelty of this model provides more interest and diversity in the overall presentation, and a more easily understood (and light hearted) visualisation of the concept. Participants can operate the model if time permits.

#### Terminology exercise

This exercise is intended to help participants gain a better understanding of the (statistical) terminology associated with forecasting, such as means, medians, probability of exceeding (80% and 50% ). It also provides participants with an opportunity to stretch their legs!

Participants are asked to line up against the back wall. They are representing a population of people of different sizes. The participants then rearrange themselves from tallest to shortest. This enables the concepts of median and probability of exceedence to be demonstrated and discussed.

#### Probability exercise.

This exercise clarifies the concept of probability. It relies on the use of 10 grass or cereal seed heads (something of relevance to the participant's area) seven of which have a single head, two have no head; and one has a double head. Participants work out that even when there is a 70% chance of an 'average' crop or season, there is also a 20% chance of a 'bad' season, and a 10% chance of an exceptional season.

When presented with a vase containing the 10 stems they are asked what sort of a season they are expecting. Most are confident of an average season. They then select a stem, which can be one of the three types contained and therefore reflect whether they did get a 'bumper', average or failed crop.

This provides good audience interaction and a three dimensional demonstration, highlighting the nature of probability in climatic (and hence yield) events (i.e. a 70% chance of an average season is not a guarantee of an average season).

## **References**

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Department of Primary Industries Queensland.

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## FARMER-LED TOURS: FOR ACTIVE, EFFECTIVE GROUP INTERACTION

**Rob Norton, Susan Knights**

**Longerenong College, The University of Melbourne**

### Introduction

Farm tours are a common activity for many farmer groups. Although objectives for these tours vary, most often the principal aim is to familiarise the visiting group with the farming practices in a particular district, and to increase their knowledge of how farmers in different areas adapt to change.

Most of us have hosted or participated in group tours or farm visits, sometimes with disappointing outcomes. A common criticism of these tours is that too few farms are visited, and the visitors can come away with an unrealistic picture of the farming practices in a region. Often touring groups meet mainly officials, and few farmers. Where groups do meet other farmer groups, a common problem is a lack of real communication (and hence co-learning) between the members of the touring party and their hosts, especially when groups are large.

This paper describes a process that has been used very successfully by Longerenong College (a regional college of the Institute of Land and Food Resources, The University of Melbourne) as a way of ensuring high participation and active learning by visitors and local farmers (and facilitators).

### Process

This activity is described from the point of view of a local facilitator, acting as a planner for a visiting group from another district or state. Early planning is vital and involves determining the visitors' special interests, and close liaison with a local farmer group. Planning should include discussion on best timing and the development of a brief but clear map and information package about the district (e.g. climate, populations, soils, farming profiles). Such information is used as background to the farming systems of the area and provides the touring party with something concrete to start from, in questioning their hosts. The visiting group receives the written information on the district prior to arrival, and then at an initial talk on arrival more information about the farming practices and problems is covered.

Suitable host groups would be Target 10 discussion groups, Landcare groups, TopCrop groups or similar. The host group is involved in planning the activity, which takes the form of individual members each hosting small groups of (2–4) visitors. The size of the sub-groups is based on the number that can fit into one vehicle. Each host gives the visiting group a tour of their farm and a talk about their operation.

Each sub-group of visitors is asked to collect information about the host farm visited, and to nominate a member to report back to the main group later. It is advisable to provide each sub-group with a checklist of information that they need to collect (best specified by the group itself). For

### Objective

To facilitate experiential learning to promote understanding of local farming issues and practices, by visiting farmer groups, though interaction with local groups.

example, you could aim to give visitors an overview of the crops grown and rotations used in the region, and the reasons for the crops selected.

The two groups meet and are introduced at a pre-arranged location, immediately followed by a field walk or trial inspection, where a third party outlines a series of issues confronting farmers in the area. Involvement of a local agronomist to talk about an on-farm trial, such as a fertiliser comparison or crop management trial. This places visitors and hosts (and facilitators) together: all attending a field day or similar event.

Following the formal presentation, the hosts are asked to conduct tours for 3–4 people of their farms for a couple of hours. Quite definite times should be set for the return to a meeting place, although the structure of the tours developed by the host members should be left to their discretion. Each host landholder takes their small group around their property, and discusses issues that provide unique insights into the management of their farms, that would not be communicated in a larger group. The checklist could be used at this point as an icebreaker and to initiate discussion.

Following the return of the hosts with their small groups of visitors, a plenary session is held to discuss the issues raised. A spokesperson from each visiting group provides a 5–10 minute overview of the practices and impressions of the property they have just visited. The key points raised from each presentation are summarised and points of special interest are noted for discussion later. The hosts answer questions and provide feedback

to the visitors on their impressions of the properties, problems and practices.

The discussion can conclude with an overview of the main district issues, and if possible, a social activity (e.g. a barbeque). This can aid free exchange between the two parties, a further opportunity for them to learn about each other!



Wallup Top Group hosts a visiting group to their area.

#### **Further information**

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## THE PADDOCK WALK

**John Griffiths**

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### Introduction: use of the tool

The farm walk is one of the simplest, yet potentially most powerful methods of communicating with farmers about their farms and farming systems; the interaction of the environment of the farm with crop and pasture production; and raising awareness of specific diseases and crop/pasture production issues. Farm walks should not be unstructured events if they are to deliver worthwhile results and be a potent means of participation for farmers.

There are a range of reasons for conducting a farm walk:

- to introduce a group to a specific land form and ecological system and to explore a range of management options for similar areas
- to follow the progress of a specific crop/pasture through the season, and observe its development over that period and the associated evolution of pests, weeds and diseases
- as a ‘one-off’ event to demonstrate a specific management issue on the farm, or to highlight the development of a disease, weed or pest problem
- for a group of farmers who meet regularly throughout the year to add a dimension to their meetings, to exchange ideas about management in situ, and to observe other management techniques for farm systems with which they are familiar

Some examples where the use of farm walks has assisted in communication of ideas and solutions to problems include:

- The seasonal management of white snails to ensure that they did not contaminate the grain sample at harvest.
- To assist farmers to identify new and specific pests and diseases in the paddock and to promote discuss possible management solutions for their containment.
- To demonstrate and discuss the re-fencing of a particular property to improve access and preserve remnant vegetation or soil types.

### Objectives

To enable farmers to observe or experience an issue or problem in situ and in the company of other farmers from similar circumstances. To demonstrate or debate alternative methods of handling a problem or issue, through group participation, observation and discussion of available techniques.

### Other learning outcomes

- Improved group participation and communication skills.
- Expression of knowledge held by individuals within the group in a non-competitive environment.
- Greater understanding of the interaction of farm operations with the physical and biological processes occurring on the farms in the locality

### Tool type

- Group interaction and development—in carefully selected farm paddocks.

### Materials

- Plan or aerial photograph of property to be visited, identifying soil types and other physical characteristics (e.g. location of fences, reserves and timber belts)
- Spade, trowel and plastic bags for samples
- Permanent markers and a cool box to hold samples
- SAS kit—Managing Sodic, Acidic and Saline Soils

### **The seasonal farm walk**

The seasonal farm walk is undertaken during the year at key periods in pasture and crop development to highlight the issues and to share experiences relating to the management practices used by the walk participants.

### **Prior session activity**

- . Decide, in collaboration with the farmer group, the main issues to be covered in the walk.
- . Identify the key issues on the farm and paddock and undertake the necessary research to provide you with the confidence to address the issue.
- . Based on local advice and observation, select a paddock/paddocks to represent the particular issues of interest.
- . Become acquainted with the land forms, vegetation and the issues that are likely to be raised (or questioned).
- . Encourage the farmer to invite neighbours and friends who are not group members to join the walk; especially if they have similar issues or problems for which they are seeking advice and guidance.
- . Arrange a mutually suitable time for the activity.
- . If necessary, brief a specialist in the subject and invite them to the walk.
- . Keep the number of non-farmer representatives attending the walk to a minimum.
- . Develop a number of questions or observations which can be used as openers for the walk.
- . Arrange to end the walk with a barbeque lunch or tea if that is the wish of the group



Participants on a farm walk examine pasture composition.

### The farm walk activity

1. Arrange to meet at a clearly identified place and time on the farm, to avoid confusion and delays.
2. Briefly outline (confirm) the purpose of the walk as agreed by the participants.
3. Be specific about the issues they have raised and what is likely to be seen on the property.
4. If you need to move between paddocks, ensure the minimum of vehicles is used, to keep the group together and interacting. Walk where possible.
5. Encourage the participants to outline their problems and issues and use the paddock and plant populations to illustrate these.
6. Get the participants to demonstrate their view of the issues or problems in the paddock, and explain what that means to them.
7. Using the various features of the farm or paddock demonstrate the possible solutions for the issues raised.
8. It is important to retain informality in this process, to obtain maximum participation. Remember it is a pleasant farm walk and information exchange, not a lecturing or teaching session.
9. Ensure that all the issues for which the walk was arranged are covered and details of the follow-up required are recorded at the time they are raised.
10. When the prime topics have been thoroughly explored, open up the discussion to other issues of concern to the participants and use the environment of the walk to encourage the development of their solutions and options.
11. This is useful to reinforce rapport with participants and to bring the walk to a conclusion.
12. If you have arranged for a barbeque, move to the location and allow the interchange of ideas to develop in a completely informal atmosphere.

#### SOME DO'S AND DON'TS OF FARM WALKS

- ✓ Know the area and land in which the farm is located.
- ✓ Ensure that the farmers have set the agenda for issues to be addressed in the walk.
- ✓ Know the issues that are likely to be raised.
- ✓ Be punctual, develop a good structure, and maintain an informal atmosphere to encourage every farmer to contribute and participate.
- ✓ Facilitate open discussion.
- ✓ Balance informality with the need to maintain control.
- ✓ Have all your aids on hand and in working order.
- ✓ Keep records of requests and points raised.
- ✓ Get back to the group promptly with answers to queries.
- ✗ Don't over load the group with colleagues and officials.
- ✗ Don't take more vehicles than is necessary.
- ✗ Don't lead the discussion unless it flags or diverts from the issues.
- ✓ Encourage the group to meet informally after the walk.

**Further information**

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