FARMING SYSTEMS RESEARCH: RELEVANCE TO AUSTRALIA

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Summary
Farming systems research (FSR) was introduced into many international and national agricultural research institutes in lower income countries (LICs) in the 1970s and 80s - with the purpose of improving the relevance of research for small-scale farmers. This review outlines the origin, context, goals, principles and process of FSR, mainly as conducted in LICs. The key elements of FSR include a holistic approach, orientation towards the needs of defined target groups, high levels of farmer participation and hence co-learning by farmers and scientists. There is guidance by facilitators, continuous evaluation and linkage to policy makers. The paper aims to enable agricultural professionals to assess the relevance and value of FSR to their work in particular situations in Australia and overseas.

The goal of FSR is to improve the welfare of farmers through development of farming systems. It involves the application of methods from various disciplines, first to define the constraints and opportunities for development and then to overcome these in a research process involving farmers, with specialists and policy makers. A generalised FSR procedure and various research activities are described. Initially in the LICs, a fairly standard FSR procedure was used, but FSR has evolved to encompass a range of activities commonly regarded as the realm of agricultural extension or rural development. Various alternative terms for FSR have emerged (such as FPR - farmer participatory research) to reflect the increasingly participatory nature of this type of research in the LICs, but the term FSR is retained here - to keep the focus on farming.

Basic science, applied science and FSR are compared in terms of the roles and relationships of the people involved in the research process. The implications of selecting FSR as a model for rural R&D are discussed. Achieving adequate levels of farmer participation can be a major issue in FSR - so it is important that the principal notions of participation are understood. Success of FSR in Australia will depend on developing innovative ways of achieving high levels of participation.

Current trends in the philosophy, practice and funding of agricultural research and extension in Australia make it timely to consider the wider adoption of FSR principles and practices. FSR could provide a valuable philosophical and practical basis for the trend towards greater participation by researchers with end-users and extension practitioners in agricultural development programs. However, it seems unwise to adhere strictly to any one particular model of R&D from other places: FSR concepts are being combined successfully with those from other models, such as systems learning and computer modelling, to suit the needs of particular situations.

Implication of a wider adoption of FSR in Australia for agricultural R&D organisations and professional bodies include the establishment of multidisciplinary teams with shared goals and the sourcing of funding for periods long enough to achieve outcomes. There is also a need for training in systems concepts and facilitation, for reputable channels of publication of the results of FSR and for greater recognition of participatory activities as valid forms of agricultural research.

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Introduction

The purpose of this paper is to review farming systems research (FSR) as it has developed in the lower income countries (LICs) and to discuss its relevance in Australia.

Currently, rural research and development (R&D) professionals have to choose from a number of different approaches to achieving outcomes in agriculture and natural resource management. Contributing to their dilemma is a lack of understanding of the key elements of the various 'models' of inquiry and action, and how and why these models are different. This review sets out to describe the key elements of FSR, and to enable people to assess the relevance of FSR in particular situations. The review will also enable people unfamiliar with the application of FSR in LICs to understand how it is frequently used in those countries.

The review will outline the origin and development of FSR in the LICs, distil the elements of a contemporary model of FSR, and discuss the potential and implications of this approach for application in Australia. Because of the present confusion arising from poor definition and understanding of terminology relating to FSR and similar models of R&D, a glossary of key terms is provided. Readers are encouraged to refer to the glossary, to avoid misunderstandings.

Origin of FSR

In the 1970s and 80s, FSR was introduced into most international agricultural research centres (e.g., in IRRI, ICRISAT, CYMMYT). This was in response to the perception that 'station based' research was not as relevant to local situations as was needed to ensure the generation and uptake of improved practices amongst most small-scale farmers (CGIAR 1993). This trend was followed by national research institutions in many lower income countries (Anderson and Dillon 1985).

Dillon (1976), Norman (1980) and Chambers and Gildyal (1984) outlined the main reasons for the move towards a FSR approach in the LICs during the 1970s and 80s:

- there was a realisation that models of discipline-oriented research from the industrialised countries were inappropriate as the basis for agricultural improvement in most LICs, where the complex farming systems were little understood;
- few innovations proposed by specialist technical researchers were being adopted;
- the vast majority of farmers lack influence in shaping research and development strategies;
- many agricultural programs have led to benefits for larger farmers at the expense of poorer families;
- most experimentation has been conducted on research stations, which are largely unrepresentative of conditions on the majority of small farms;
- the FSR approach is consistent with current political notions of equity and sustainable production;
- research focussed on components or commodities and/or productivity alone has sometimes led to land degradation.

Several Australians have played prominent roles in promoting and developing FSR in the LICs (e.g., Dillon 1976; Byerlee et al 1982; Anderson 1985). However, until recently in Australia, the term FSR has usually applied to research emphasising some form of hard systems (i.e., computer) modeling of biological or economic aspects of farming. The definition has often been vague and there was little reference to the international literature on FSR (Remenyi 1985). There has been a similar dichotomy between the use of the term FSR by European scientists operating in developing countries, and the nature of farming systems research in Europe itself (Gibbon 1994).
Development of FSR in lower income countries (LICs)

Initially FSR followed a fairly standard procedure, involving selection of research sites, description of farming systems, diagnosis of constraints, and trials on farms aimed at testing mainly technological ideas for improvement. In the 1980s and 90s FSR extended to encompass a range of activities previously regarded as the realm of agricultural extension or rural development (Biggs 1995). Alternative terms arose for FSR-type programs, including FSRD (FSR and development), FSR/E (FSR and extension), FPR (farmer participatory research). Very notable has been the trend in FSR towards greater participation by farmers in the research and development process (Okali et al 1994).

Most early FSR programs were initiated within agricultural research agencies. With the strong trend towards greater participation by farmers, FSR activities have more recently been embraced by agricultural extension agencies (Rolings 1988; Okali et al 1994), sometimes under new names such as farmer participatory research.

During the development of FSR, various “schools” have promoted particular types of FSR, which differ from the contemporary definition provided in this paper. Examples are Francophone FSR, where the main concern has been for long-term land utilisation issues, rather than for improvements in the welfare of farmers. A similar (upstream) approach has been that of programs of “New Farming Systems Development”, such as one at ICRISAT in India, which attempted to develop (replacement) systems for the vertisol sub-region of India (Reddy and Wiley 1982). Another category of FSR has been “Farming Systems Analysis”, which involves detailed description and analysis of farming systems, but little or no research with farmers to effect improvements (Simmonds 1985).

FSR has sometimes been introduced to LICs on a program basis, and sometimes as a philosophy across a number of programs (e.g., agronomy, crop, livestock) within research institutions. An international study of FSR in nine countries (Merrill-Sands et al 1991) concluded that there is no ideal format for the institutionalisation of FSR, but that for success, FSR programs should have:

- an identifiable structure, set up so as to encourage multi-disciplinary participation;
- FSR activities should determine staffing, rather than the reverse;
- training in FSR concepts for all managers and scientists;
- leadership by a person with a holistic view of farming;
- strong links to regional priorities / development projects;
- access to, or capacity for, skilled disciplinary research;
- adequate recognition for participants and farm research;
- opportunity for peer review.

Implicit in these recommendations is the major need for a budgeting and incentive structure that encourages, rather than discourages, both a team approach to research and direct involvement with farmers (Anderson and Dillon 1985; Petheram 1985).

A Contemporary Description of FSR

Context

Most agricultural research has (traditionally) been organised on a compartmentalised basis – of disciplines (e.g., agronomy, breeding, economics) or commodities (e.g., cotton, wool) (Dillon 1976). A systems approach, on the other hand, recognises that all components of systems are linked and therefore affect each other, and that the properties of a system amount to much more than just the sum of the parts (Spedding 1994).

FSR is a soft systems approach (Willson and Morren 1990) that can incorporate all types of inquiry, as considered appropriate by the participants, e.g., applied science (social, economic, biological), hard systems or even basic science. It is participatory and involves cycles of observation, diagnosis, action and evaluation.
Agricultural research has traditionally been conducted by technologists on components of a system on problems defined by technologists. FSR, in contrast, involves the application of methods and knowledge from various disciplines and sources (including the end-users), first to define the constraints and ideas for improvement in existing farming systems, and then to overcome the constraints and test the opportunities with farmers (Dillon and Anderson 1984; Simmonds 1985). FSR is inherently long-term, as farming systems include people, crops, animals and their interactions with markets and other long-standing social structures.

**Goal and principles of FSR**

The overall goal in FSR is to improve the benefits to farm families, through improving the performance of their farming systems (McCown 1991). The benefits for researchers and policy makers are increased relevance and effectiveness in achieving outcomes.

The main principles in FSR are a systems approach, participation by farmers, partnership, and evaluation as part of the process. It has both a holistic and a behavioural component (Doppler 1994). Holism includes consideration of biological, environmental, social and economic aspects, including their dynamics over time. The behavioural component involves the participation by farmers with researchers in defining problems, and selecting and implementing and evaluating solutions.

**Key elements of FSR**

FSR may be viewed as a research approach or a model of inquiry. Some elements of the model (from Casey and Barker 1982; McCown 1989; Gibbon 1994) are listed in Table 1.

**Table 1. Elements of a FSR approach**

<table>
<thead>
<tr>
<th>Key element</th>
<th>Description</th>
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<tbody>
<tr>
<td>Goal</td>
<td>To improve the welfare of farmers through improving the sustainable production of their farming systems.</td>
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<tr>
<td>Research aims</td>
<td>To develop and share knowledge and understanding of “what, why and how farmers do what they do” and the effect that change would have on farmers’ systems, welfare and surroundings. This is “co-learning”.</td>
</tr>
<tr>
<td>Target</td>
<td>FSR usually has defined farmer domains as its clientele, e.g, dryland crop farmers with sheep as a secondary enterprise.</td>
</tr>
<tr>
<td>Leadership/facilitation</td>
<td>FSR requires facilitators who understand the principles of systems inquiry, science, community and local agriculture.</td>
</tr>
<tr>
<td>Multidisciplinary mode of action</td>
<td>It attempts to explain the most important components (physical, economic, social, political) of the selected farming system, and then seeks solutions to the constraints, through participation by farmers and appropriate specialists.</td>
</tr>
<tr>
<td>Type of research</td>
<td>FSR involves different types of research, allowing people from different disciplines to work towards common aims.</td>
</tr>
<tr>
<td>Participation</td>
<td>Contemporary approaches to FSR involve farmers, specialists and policy makers in various levels of participation. Many methods used in FSR are aimed at enhancing participation.</td>
</tr>
<tr>
<td>Holistic</td>
<td>It considers whole systems. However, FSR may emphasise certain components (e.g, rice or beef) while considering the system as a whole.</td>
</tr>
<tr>
<td>Relation to disciplinary research</td>
<td>FSR provides a way of contextualising disciplinary research and focussing it on the immediate needs of farmers, by enabling farmers to influence the process of R&amp;D.</td>
</tr>
<tr>
<td>Feedback and evaluation</td>
<td>The close participation allows constant feedback and hence ownership by farmers and other stakeholders in the process.</td>
</tr>
<tr>
<td>Relation to extension</td>
<td>Most FSR involves extension agents in research. However, where the FSR process reaches only some farmers, further extension of results is needed. Some programs (FSR&amp;E) are</td>
</tr>
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</table>
designed from the outset to reach a wider audience.

**FSR as research (or extension)**

FSR is a process of “research” and “co-learning” - with a view to improving knowledge and understanding, and hence developing the farming system in a way desired by the participants. It involves iterative stages of observation, analysis, action and evaluation, carried out jointly by farmers and scientists and/or other specialists. This model of action research has many features in common with sound extension practice (e.g., Woods et al 1993). However, communicating the results/benefits to those not directly involved in the FSR process usually requires further extension activities.

Because farmers and other stakeholders are intimately involved in the process and much of the action is people-oriented rather than science oriented, FSR has been viewed as “extension” rather than research by many traditional agriculturalists. The distinction seems immaterial; and FSR is often carried out jointly by research and extension agencies.

**Process**

The mode of action in FSR is to study the selected farming system (physical, biological and socio-economic) and then define and solve problems through an involvement with the farmers, rather than for them as in traditional research.

In the LICs, many of the constraints and opportunities in development of farming systems involve socio-political (rather than technical) issues. FSR recognises the need and opportunity to influence policy-makers, to attain positive change. This is mainly achieved through establishing links with policy agencies, and then clear documentation (and communication) of the system description, and the constraints and opportunities defined.

Casey and Barker (1982) described FSR as an evolutionary process, with the technique itself developing out of an interaction between scientists, farmers and the physical, socio-economic and biological factors that constitute a system. Remarkably similar procedures for the conduct of FSR have evolved in a number of different LICs and institutions. One generalised FSR model from the LICs is shown in Figure 1, which is followed by a brief outline of each stage of research. The close partnership of scientists, farmers and other stakeholders in FSR, allows continuous feedback and evaluation, so the process is continuous and cyclical, rather than linear as depicted in Figure 1.

The methods used at each stage of FSR and the emphasis and time spent on each, depend upon the nature of the farming system, the availability of relevant data and research resources, and the level of support from extension and other agencies. FSR activities internationally have varied from land classification to informal surveys, action research with farmers, to scientific experiments or hard systems modelling (Simmonds 1985). The emphasis in the LICs, however, has been on-farm research, first to describe the systems and then to test ideas for improvement.
1. CLARIFY OBJECTIVES
   -- regions
   -- enterprises
   -- goals

2. SELECT RESEARCH SITES

3. DESCRIBE EXISTING FARMING SYSTEM
   --- develop socio-agro-economic profiles
   --- diagnose constraints & opportunities

4. DESIGN POSSIBLE IMPROVEMENTS TO SYSTEM

5. TRIALS ON RESEARCH STATIONS

5. SCREEN OTHER IDEAS NEEDING SUPPORT
   (Non-farm)

5. TEST IDEAS FOR IMPROVEMENT IN FARM TRIALS

6. COMMUNICATE TESTED IDEAS TO EXTENSION AGENCIES, KEY STAKE-HOLDERS AND POLICY MAKERS

7. EVALUATION AND COMMUNICATION TO A WIDER FARMER AUDIENCE

Figure 1. A model for farming systems research similar to that used by many FSR programs in lower income countries (e.g., Okali et al 1994).

Notes: The process is cyclical and has in-built evaluation.
For Australian models see e.g., McCown (1991), APSRU (1991).
Two major activities within FSR that are not reflected in Figure 1 are those associated with participation and continuous evaluation. Achievement of adequate participation by farmers and other stakeholders can constitute a considerable proportion of the time in research.

An example of a schedule of activities in the first two and a half years of a livestock-oriented FSR program in Indonesia (adapted from Petheram 1996) is shown in Figure 2.

### Research activities in FSR

Each of the stages (1-6) depicted in Figures 1 and 2 is regarded as a “research activity”. The FSR literature covers numerous techniques for use in research at each of the stages, and compares their relative merits and costs (e.g., Gilbert et al 1980; Byerlee et al. 1982). A brief outline of each stage of FSR, taken mainly from FSR practice in LICs, is given below - in the same sequence as the activities shown in Figures 1 and 2.

1. **Clarification of objectives and analysis of regional data**

   As FSR is long-term and can invoke major commitments in resources, a vital first step is to clearly define objectives. Many of the objectives that need to be clarified are political and concern which region, farming system, boundaries, and target farmer domains (e.g., rich or poor, degraded or sustainable) and what outcomes (e.g., production, welfare, sustainability) are to be targeted. It is, however, common in FSR for specific research objectives to change over time, as understanding of the systems (physical and human) improves.

   In FSR, therefore, there must be continuous interaction with decision-makers about the
resources needed and their allocation. In the LIC context, this requires careful prior analyses of relevant data on the region, to enable clear justification to policy makers of the aims and plans for the research and the selection of research sites. Consequently, data tabulation, checking, analysis and mapping can constitute an important preliminary stage of research. Clark et al (1996) argue that (in the Australian context) farmers should be involved in this process from the outset.

2. **Selection of sites for FSR**

A FSR site is an area comprising farms that represent the particular farming system of interest. In the LICs the unit for research sites is often a village or hamlet, while in Australian conditions a site is more likely to comprise a number of farms in an area representing the farming system of interest. Selection of sites requires clear prior definition of aims, farming systems, and farmer domains of interest (e.g., maize growers on acid soils with less than 0.5 ha of land). A set of agro-ecological criteria for site selection is established to fit the objectives and the resources of the project, and the community’s willingness to cooperate is used as a crucial selection criterion. Santoso et al (1987) outlined the selection of village research sites to represent various (altitude and livestock) zones for a FSR program in Java.

3. **Description of farming systems**

The purpose of Description (or the diagnostic phase) is to understand the farming system and to document an "agro-economic profile" of each research site. This profile includes key information needed to understand and diagnose problems and opportunities for change. FSR utilises efficient and effective ways of gathering data for diagnosis of systems, and avoids time-consuming methods such as formal surveys and long-term monitoring of farmer activities, where possible.

Rapid Rural Appraisal (RRA) is a repertoire of techniques that was developed within FSR in response to the need for faster and more effective collection of important information on farming systems, e.g., the use of various “listening” techniques, group interviews, or of aerial photography to measure land areas (Carruthers and Chambers 1981; Beebe 1985). In Australia, RRA has come to have a somewhat different meaning, involving the use of multidisciplinary teams to identify issues in rural areas (Dunn 1994).

Typically in FSR, “Description” embraces both conventional and RRA methods adapted to the situation, e.g., “rapid” surveys of farmers’ conditions and views, combined with sampling of soil and other data. Usually, more than one method is used to obtain information on each aspect, such as crop yields, calving rate or marketing. Special studies are also used to obtain information on important topics, e.g., existing innovations, or markets (e.g., Perkins and Sturgess 1992). In the LICs, the use of RRA in description has been criticised as too “extractive”, and has sometimes been replaced by PRA (participatory rural appraisal) which purports to give greater attention to farmers views and involvement in the descriptive process (e.g., Chambers 1994).

The profile developed for each research site serves to inform all those involved in the FSR process, of the main features of the farming system and the main constraints and opportunities (e.g., Hoang and Perkins 1996). The profiles of research sites conclude with a list of major constraints and opportunities identified for "improvement" of farmer benefits from the system (e.g., new pest control methods, training for farmers).

Several authors in Australia report using participative methods that resemble the descriptive stage of FSR (Figure 1). A form of RRA was used by Ampt and Ison (1988) to identify needs for agronomic research in the Forbes Shire, and also by Dunn and McMillan (1992) to inquire into Landcare issues near Wagga Wagga. Petheram and Fisher (1995)
described sheep sub-systems in the Wimmera region, and Millar and Curtiss (1995) used qualitative RRA methods to assess farmer knowledge and experience of the management of perennial pastures. Clark et al (1996) report success with a technique called "local best practices" to describe local situations in terms of needs, problems, opportunities and alternative solutions.

4. **Design of possible improvements**

The aim in the Design stage of FSR is to generate ideas for improvement to the existing system, which are practical and attractive to farmers. Design involves assembling a pool of ideas for "improvement". These are "screened" with farmers and specialists, in terms of physical and economic feasibility, social acceptability and likely effects on the surrounding system (Anderson and Hardaker 1979).

Dillon and Virami (1985) mentioned the potential of using simulation models to assist in the design process in situations where sufficient data are available. The term "operations research" has been used in FSR in Australia to describe a process in which computer models are utilised to aid scientists and farmers in designing improvements to farming systems (APSRU 1991). These models can become participatory tools and a means of exploring and screening alternative strategies in the design process. Clark et al (1996) describe a technique of "specialist questioning" used to generate specialists' descriptions and opportunities for improving production systems. The same authors, and Foale (1997) describe how models can be used to help in determining, with farmers, which options can have a significant pay-off to the farming system.

In the LICs, computer modelling has seldom been seen as an appropriate tool in developing small-scale farming, as so few quantitative data are available and socio-economic constraints are generally more important than biological ones (Remenyi 1985). The design process therefore depends on selecting various best bet options and testing or screening these ideas for practicality amongst farmer participants. In Queensland Martin et al (1996) have combined the use of computer models and best-bet trials on farms in an (FSR) approach called "co-learning".

5. **Farm testing, trials on research stations, and other ideas for improvement**

On-farm testing is a major feature of FSR in the LICs and the design and management of farm trials is strongly debated in the literature (e.g., Ashby 1985; Farrington and Martin 1988). Trials have been classified according to the degree of involvement of farmers and research workers, e.g., researcher designed and run, researcher designed and farmer run, farmer designed and researcher run, or farmer designed and run trials.

On-farm trials with crops (e.g., Nygard 1982) have been much more common than those with livestock, where a perceived difficulty is in the small numbers of animals on farms and the high variation within and between farms (e.g., Nordblom et al 1985). However, experience suggests that the statistical analysis of results of farm trials with livestock (and even crops) is generally far less important than the information gained from researcher contact with farmers and farmer opinion of the practicality of the ideas being tested (Petheram et al 1989).

Thus the aims of trials on small-scale farms in LICs are usually different to those of research station experiments. Generally, farm trials are neither controlled experiments nor a means of extension, except to small pilot groups of farmers who participate in trials aimed at gauging practicality and reactions to new ideas.
In new FSR programs in LICs, there are usually enough ideas for improvement of systems to allow an initial emphasis to be placed on trials of "best-bet" ideas on farms, rather than experiments on research stations. As FSR progresses, there is often a build-up of topics requiring more controlled experimentation on stations (Horton 1984). There are many instances of the relevance of station-based research programs being greatly improved through information gained from trials on farmers’ crops and animals (Collinson 1987; Merrill-Sands et al 1991). Experiments on stations may be a part of FSR, or may be conducted by other programs, as a result of FSR.

Not all ideas generated at the design stage of FSR are amenable to testing on farms. Many ideas for improvement will involve the removal of socio-economic or other constraints, such as marketing barriers, restrictions on credit, and lack of access to training for farmers. The practicality of such ideas may need testing or screening generally amongst farmers and other local stakeholders, before a larger scheme of intervention is proposed for consideration by policy makers.

6. Communication of ideas to extension agencies, policy makers, other stakeholders

FSR is often relatively site specific (Menz and Knipsheer 1981) in that only a limited number of research sites can be used and participation can be with only a small sample of farmers. The responsibility for the communication of “tested” ideas from FSR to a wider audience will depend on whether and how extension agencies are involved in the FSR process from the start. While FSR programs do not usually have an explicit extension role, in some (FSR/E) projects, extension agents facilitate FSR and the research and extension responsibilities are therefore integrated.

The results of farm trials and other “tested” ideas for improvement of farming systems will need to be communicated to policy makers as well as other stakeholders, as they may then require long-term strategies of intervention, e.g., training, credit or other support. Linkages in FSR to both extension agencies and policy agencies are therefore critical.

There is growing recognition by FS researchers in LICs that FSR is only one element in agricultural and rural development, and that much can be gained through collaborating with agencies that have better understanding of rural needs and priorities, particularly of poorer people (Farrington et al 1993; Gibbon 1994).

7. Evaluation in FSR and wider communication of results

Although evaluation is shown in Figure 1 as part of a later stage of FSR, it occurs informally throughout the FSR process through the continuous access to and feedback from farmers. In contemporary FSR, action research concepts used to manage the research process ensure regular refection, conclusion and planning after action. Farrington and Nelson (1997) propose the use of formal frameworks for evaluation, such as log-frames established at the conception of a FSR project.
The Choice of FSR and Implications for its Application in R&D

**FSR and types of research**

Decision-makers in rural R&D have to make crucial decisions at the outset of an initiative to improve a problem situation - about the type of approach they are going to take. FSR is but one of numerous models of rural inquiry and development from which a selection can be made (Jiggins 1993; Ison et al 1997; Grimble and Wellard 1997; Martin and Sherington 1997). The appropriate model (or combination of models) will depend on the particular situation.

In this context, it is useful to consider various stages and types of research, as discussed by other authors. In Table 2 six stages of a research cycle (Rowan 1981) are related to three broad types of research, i.e., ‘basic’, ‘applied’ and ‘participative’ (Elden 1981). Comments are provided on the relationship between researchers and their subjects/clients/colleagues, at each stage and within each of these broad types of research.

Table 2. Six stages of research and implications for the roles and relationships of researchers and clients/colleagues within three different types of research

<table>
<thead>
<tr>
<th>Research stages</th>
<th>Types of research, and roles and relationships between people involved</th>
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<tr>
<td></td>
<td>Basic</td>
</tr>
<tr>
<td>1. Problem identification</td>
<td>Researcher</td>
</tr>
<tr>
<td></td>
<td>Applied</td>
</tr>
<tr>
<td>2. Problem analysis/refinement</td>
<td>Researcher</td>
</tr>
<tr>
<td></td>
<td>Participative</td>
</tr>
<tr>
<td>3. Planning</td>
<td>Researcher</td>
</tr>
<tr>
<td></td>
<td>Research with some input for client</td>
</tr>
<tr>
<td>4. Implementation</td>
<td>Researcher</td>
</tr>
<tr>
<td></td>
<td>[Researcher - object/subject relationship]</td>
</tr>
<tr>
<td>5. Analysis</td>
<td>Researcher</td>
</tr>
<tr>
<td>1. Communication</td>
<td>Researcher</td>
</tr>
<tr>
<td>How the end-users acquire knowledge of the products of research (in order of greatest use).</td>
<td>1. Information communication</td>
</tr>
<tr>
<td></td>
<td>2. Education</td>
</tr>
<tr>
<td></td>
<td>3. Training</td>
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In typical basic and applied science models, the clients/end-users are not co-learners in the research process, so the communication stage is particularly important to ensure...
positive outcomes are achieved in these types of research. In FSR (and other soft systems approaches), the research process evolves out of interaction between scientist, farmers and other stakeholders (Casey and Barker, 1982) and can utilise any or all of the three types of research (although the emphasis is on a participative approach in the LICs, especially in the LICs).

Crucial to the selection of different approaches is the nature of the problem situation. If the problem is highly technical, compartmentalised and/or well defined, then basic research may be appropriate. If the problem is complex, involving systems and involving people with different values and perceptions, then participative approaches are claimed to be more effective (e.g., Whyte 1991).

**FSR and management of participation**

In planning and managing participative models of research, it is important that the concept and principle notions of participation are clearly understood, and that these are applied with rigour. Burke (1968) stated that the appropriateness of any strategy of participation is highly dependent on the capabilities and knowledge of the people who implement it. Arnstein (1969) defined participation as a redistribution of power and described eight levels of participation which range from ‘manipulation’ through ‘consultation’ and ‘partnership’, to ‘citizen control’. The issues of power and control over the research process are problematic in the conduct of community-based research.

Some reasons for using high levels of participation (quoted mainly from Burke 1968) are:

- participation in an adult learning environment provides for the development of outcomes matched to the needs of those involved;
- it is easier to change the behaviour of people when they are members of a group than when they are approached as individually;
- if people are involved in problem identification they are more likely to ‘own’ solutions and be motivated to implement action to resolve problems;
- individuals and groups resist change imposed on them.

Some criteria for high levels of participation are that the individuals must:

- have a strong sense of identification with the issues or group;
- gain satisfaction from participation;
- possess appropriate skills, competencies and/or perspective’s.

Martin and Sherington (1997) contend that participatory research is dependent on establishment of strong farmer (and other) organisations. Because participation is usually such an important a component of FSR, innovation by facilitators in methods to achieve farmer cooperation has become as critical a part of research as scientific method. Examples of techniques used in strengthening farmer participation in research in LICs range from the use of community video filming, to farm trials and farmer contests (Petheram et al. 1995), or to workshops in which farmers build models of ways of integrating new enterprises on their farms (Okali et al. 1994).

It is notable that in Australia too, "enhancing creativity" in gaining farmer participation has emerged as an important need in the context of development of sustainable farming systems (Hamilton 1997; Mudenda and Frank 1993). Chamala and Mortiss (1990) produced a text on techniques aimed at enhancing farmer participation in Australian Landcare activities. R & D workers have adopted various participatory approaches and techniques, such as involving farmers in using computer models (APSRU 1991), farmer-scientist co-learning models such as that of Foale et al (1996), Local Best Practices (Clark et al 1996), and Learning to Learn with Farmers (Hamilton 1995).
Overseas, and to a lesser extent in Australia, there has been a burgeoning of approaches to the management of participative research; e.g., Participative Action Research (Elden 1981; Whyte 1991), Farmer Participatory Research (Okali et al 1994), Participatory Problem Solving (Clark et al 1996), Participatory Rapid Appraisal (Chambers 1994) and Participatory Farming Systems Development (Jones et al 1996). These models all share common concepts with FSR, but their focus is often on the community (or e.g., a factory), rather than on farmers in a defined farming system as in FSR.

**FSR and other systems approaches**

Various authors have advocated a move towards a much more systems oriented approach to agricultural R&D in Australia than has been seen in the past (e.g., Bawden and Valentine 1984; McCown 1989; Schoorl and Holt 1990; Squires 1991; Macadam 1996). In recent years there has been quite widespread establishment of “farming systems” programs within State departments of agriculture across Australia, although there is little uniformity in approach. In addition, there has been a spread of “farming systems” projects based on farmer groups seeking to develop local farming through farm trials (e.g., Pedley 1995). This diversity may represent a search for appropriate models of FSR for Australia, but there appears to have been little reference to international literature involved in the formation of this spectrum of new FSR programs and projects.

Once a decision has been made to take a systems approach in R&D, rather than a mainly compartmentalised approach, there are controversies over the merits and demerits of various systems approaches to be considered. One prominent early school of systems thinking in Australia was that of the University of Western Sydney (Bawden and Packham 1991), which placed emphasis on "systems learning" (or “experiential learning, e.g., Kolb 1986).  Bawden (1991) observed that FSR has tended to emphasise the need to understand the bio-physical system, rather than the more important human learning aspects. Others claim that FSR has placed too much emphasis on procedure, or that it has lacked concern about policy issues in the improvement of systems (Biggs and Farrington 1991).

These observations have some truth but give no recognition to the fact that most FSR in LICs began within very traditional agricultural research institutes. In such situations, a fairly formal (FSR) procedure has been seen as a necessary starting point, until scientist/members become comfortable and enthusiastic about working in a systems manner. Considerations of institutional setting are essential is establishing FSR, and in its evolution towards effective programs (Heinemann and Biggs 1985). Early FSR programs seldom had a brief to look beyond technology generation and testing. Most FSR procedures in LICs today (and many in Australia) are tailored to meet the needs of particular situations and to promote participation at all stages.

Ison et al (1997) identified three main strands of systems practice in natural resource management: systems learning, FSR and quantitative systems modelling. They claimed that in systems learning approaches, the term system is used as an adjective, while in FSR it is used as a noun. In the systems learning model, the farming system is not considered as a reality, while in FSR the farming system tends to be the focus of description, diagnosis and action. This distinction may be valid for the early years of FSR, but is not relevant nowadays, where there is a blending of models and FSR programs often adopt a “systems learning” framework. The terms are not mutually exclusive.

Okali et al (1994) observed that the term FPR (farmer participatory research) has replaced FSR in some organisation (e.g., Witcombe et al 1996), but that there is little point in
arguing over the relative merits of the terms. FPR tends to place less emphasis on describing systems and more on farmer empowerment and ownership of the research, but the aims are almost identical to those of FSR. The term FSR/E has been defined as FSR that goes beyond farm trials, to extend farm-tested ideas amongst the wider farmer population (Christoplos 1995). Wilson and Morren (1990) provide a general account of systems approaches for improvement in agriculture and natural resource management, mainly in the north American context.

Conway's (1985) "agro-ecosystems analysis", developed mainly in S.E. Asia, has similar aims to FSR, but has an ecological emphasis and prescribes a particular set of techniques and concepts in describing systems (such as analysis of patterns over time and space). Gibbon (1994) stated that such ecological concepts can be valuable in describing farming systems in Europe and in predicting the long-term effects of change in certain situations.

In Australia the various strands of systems inquiry are increasingly being used in combination. Figure 3 shows four main strands of systems inquiry in agriculture at four poles of a circle; the trend in FSR in the 1990s is towards the integration of concepts from the other three approaches.

![Figure 3 Four main strands of systems inquiry in agriculture (dark). The expansion in FSR approach from 1970s to 1990s has been towards greater participation and adoption of systems learning concepts](image)

Much 'agricultural systems research' in Australia and other western countries has comprised hard systems modelling of aspects of farming systems (Remenyi 1985). White

Since the 1980s in Australia there has been a rapid increase in the development of computer models of parts of farm systems, intended as decision support tools for farmers (Stafford-Smith et al 1997; Nunn et al. 1993). The use of such hard systems models is increasing slowly as farmers and extension agents gain confidence with computers and as modellers improve the utility of models (Clark et al 1996; Woods et al 1993).

Relevance of FSR in Australia

Some reasons that have been put forward in the literature for an increase in the relevance of FSR approaches in Australia include:

- a system approach is more likely to improve the identification of “real” problems and solutions than approaches based on the assumption that opportunities lie within specific components or research disciplines;
- increased specialisation and staff cuts in research institutions have led to a shortage of agriculturalists with sound general knowledge of farming systems;
- regional statistics are too broad to adequately reflect local conditions and change, or the needs in farming (there is need for reliable information on local systems);
- there are disputes over the "representativeness" of farmer members of research funding boards: the majority of farmers may not have a voice in shaping research;
- there is increasing concern about land degradation - a field in which participation and understanding the system are very important to achieving improvement;
- there is recognition that different groups (or domains) of farmers, even in the same area, may have very different needs for research and information;
- "transfer of technology" is increasingly being seen as an outdated model of extension for dealing with complex systems;
- present trends suggest that much of the improvement to farming systems in the future is likely to come from farmer groups following their own inquiry process - in partnership with facilitators and specialists.

A FSR approach may therefore offer fruitful direction, philosophy, linkages and literature to many research and extension professionals in the current climate of change. FSR would bring the activities of research and extension closer, and also result in much closer linkages to farmers and communities.

It is clear from the literature that, until recently, the development of a farming systems approach has been primarily the concern of research organisations in LICs. Evidence of recent interest in FSR/E in Europe (Dent and McGregor 1991) and developments in farmer participatory and systems research in Australia (e.g., APSRU 1991; Martin et al 1996; Foale 1997) suggest that it is now pertinent for "western" research and development professionals to study the international literature on FSR and to assess its relevance to their particular situations.

Recent studies indicate that farming systems in Australia and the views of farmers are not at all well understood and that there is a need for FSR-type diagnostic studies in many areas and industries (e.g., Mason and Kay 1995; Clark et al 1996). Concepts of systems (and farmer participatory) research adapted from the LICs appear to be gaining acceptance as models that offer great potential for “co-learning” by farmers and researchers. The initiatives of R&D funding organisations to promote such research
should help greatly to advance the adoption and development of FSR and related approaches.

Conclusions

In Australia the adoption of FSR concepts appears to have increased markedly in the past five 5-10 years. However, FSR programs are evolving rapidly and range widely in type - from groups of farmers running farm trials involving local advisers, to much more formal programs run by scientists (or modellers) who seek strong participation of farmers in contributing and evaluating ideas from research stations, models or farms. Some common features of FSR are participation, co-learning and a holistic view that includes consideration of human aspects of farming, including human learning. Observations from the literature suggest that:

1. Systems approaches are more likely to define opportunities for making a real difference to farming on an enterprise and a regional (or catchment) scale - than research into components alone.

2. High levels of participation are required to achieve change in complex (attitude and value laden) issues in agriculture.

3. The choice of R&D approach such as FSR has major management implications:
   - multidisciplinary teams need to be set up with shared vision and purpose;
   - funding needs to be sourced for periods long enough to achieve outcomes;
   - planning should include strategies/opportunities to influence policies;
   - goals and objectives may change as the inquiry proceeds.

4. Major challenges facing those adopting a FSR approach will be:
   - to develop FSR models that fit the institutional setting;
   - to convince traditional researchers of the relevance of FSR and the need for real participation by farmers and specialists in the process;
   - to develop innovative means of achieving high levels of participation;
   - to develop skills in facilitation personally and amongst other participants;
   - to achieve recognition for results or FSR through outcomes on farms, as well as through publication and peer review.

5. The wider adoption of FSR in Australia has implications for rural R&D professions, which need addressing by organisations and professional bodies. These include:
   - provision of training in FSR concepts for R&D funders and managers;
   - provision of training for prospective facilitators of FSR;
   - creation of reputable channels for publication of results of FSR in Australia;
   - recognition of descriptive studies, as well as “co-learning” and other participatory activities with farmers, as valid forms of “research”.

Worldwide reviews of FSR programs indicate that for success FSR programs must be tailored well to suit to the institution setting (Heinemann and Biggs 1985). There is wide scope for combining the concepts of FSR from the LICs with those from other systems approaches to R&D, such as systems learning and computer modelling. Thus, the successful development of FSR will require the support of leaders in both extension and research who understand various systems (and other) approaches to inquiry. Another requirement would be removal of the often artificial distinctions made between research and extension - for the funding, planning and conduct of FSR and in the publication of the results.
References

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GLOSSARY

**Action research.** A process that seeks to achieve change through participatory diagnosis of a situation, planning and purposive action, in a continuous cycle. Repetition of the cycle leads to understanding of the system and of the methods being used.

**Applied science.** An approach to inquiry using basic science principles to create solutions (e.g., technology) to real-world problems.

**Approach.** A way of going about doing something.

**Basic science.** An approach to investigating the nature of a property or phenomenon, using the principles of reduction, experimentation, replication and refutation.

**CIMMYT.** International Maize and Wheat Improvement Centre.

**Clients.** People identified as being the beneficiaries, e.g., of research or extension.

**Commodity.** Relating to agricultural products, e.g., wool, beef, grain.

**Co-learning.** A participative process involving discussion and dialogue, reflection, interpretation, planning and purposeful action.

**Disciplinary.** Relating to a traditional agricultural discipline, e.g., agronomy, genetics.

**Extension.** Processes to achieve positive outcomes for people. This usually involves changes in: knowledge, skills, practices, attitudes and/or aspirations.

**End-user.** A person who is targeted to be a beneficiary of a project or process.

**Evaluation.** Process of assessing the value of

**Facilitator.** A person who uses facilitative, rather than authoritative, approaches to intervention, group organisation, learning and action.

**Farm.** An organised unit in which crop, livestock and/or other activities are carried out to satisfy the farmer’s goals. Not necessarily a single tract of land, or involving land at all.

**Farmer.** The operator of a farm. May mean more than a single decision maker, e.g., the family, household, company.

**Farmer domain.** Group of farmers with common needs for research and extension (referred to as target group when they are the target of R&D).

**Farming system.** A collection of farms that are managed in a similar way by farmers with similar environment, goals and resources.

**Intervention.** Deliberate interference in a situation involving others.

**Hard systems approach.** Involves quantitative computer modeling (e.g., of the biological or economic aspects) of systems; usually with little incorporation of people in the model. “Hard” means that the problems, goals and desired outcomes are readily defined by the analyst (Wilson and Morren 1990). (see soft systems approaches).
Holism. The practice of viewing the world as consisting of structured wholes (systems) that maintain their identity and properties. The major propositions are that everything is connected and that the whole is different to the sum of the parts.

ICRISAT. International Crops Research Instutute for the Semi Arid Tropics.

Inquiry. Investigation (research).

IRRI. International Rice Research Institute.

Knowledge. Facts of experience or theory known by a person. Organised and processed data which convey meaning in the context of a current situation.

Method. A way of doing something (in an orderly manner).

Model. A simplification, representation or other copy of reality.

Outcome. Result.

Participate. To become actively involved is a process which includes decision-making and which is transparent and without hidden agendas.

Process. A series/combination of actions which produce a change, output., development


Soft systems approaches. In which people are intimately involved, objectives are hard to define, decision-taking is uncertain, and measures of performance are often qualitative (see hard systems approach) (Spedding 1996).

Stakeholder. A person who has a significant interest in group processes for rural development but who is not necessarily a direct participant in the processes.

System. An arrangement of components that function as a unit, each part interacting with the other parts, and affecting the properties of the whole.

Systems learning. A term related to “experiential learning” (e.g., Kolb 1986) and based on the concept that learning occurs through cycles of observation, reflection and action.

Target group. See farmer domain.

Technique. A way of achieving one’s purpose, e.g., of an extension agent establishing a relationship between the learner and an issue.

Technology. Means of achieving a practical end; often (but not always) the product of applied science (see Applied science).

Tool. Something that serves to extend the effectiveness of methods and techniques.

Understanding. The ability to learn, apply concepts and principles, judge and make decisions (in a topic area).