# Back to the future - Reinventing farm management economics in farming systems research

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**ABSTRACT**

In the main, Australian agricultural economics has been in the background in the recent trend toward convergence of research and farming practice which has become known as Farming Systems Research (FSR). However, the inherent importance of good economic performance of farms suggests that FSR that is effective in supporting farm management practice might well include economics. There was a time when economics played a dominant role in a direct link between farming and research about farming. This was in the days of a research movement known as Farm Management Research (FMR). Lessons from the subsequent rise and fall of the FMR era seem to have gone largely unnoticed by conventional agricultural research. However, the demise of FMR made some important contributions to the idea and development of the FSR approach in lower-income countries. Maybe it is time to ask if the reports of the death of FMR have been exaggerated, and if within a dynamically evolving FSR, a reinvention of FMR might be desirable and feasible in Australia? This paper examines this possibility. We conclude that there are opportunities to bring economists from the background to the foreground of FSR by using 'hard systems' tools, such as systems simulation, in new ways through participatory action research.

**KEYWORDS**
Farming systems research, farm management research, economics

**INTRODUCTION**

A national symposium on Farming Systems Research (FSR) represents a significant shift of focus in Australian R&D in recent years. In the main, agricultural economics has been in the background in this recent trend toward convergence of research and farming practice. Yet, there was a time when economics played a dominant role in a direct link between farming and research about farming. This was the era of Farm Management (FM), also known as Farm Management Research (FMR). Although the demise of FMR by the late 1970s, as described by Malcolm (22), seems to have gone largely unnoticed by conventional agricultural research, the inherent importance of good economic performance of farms suggests that FSR that is effective in supporting farm management practice might well include economics. If this came about, it would constitute the completion of a loop, since FSR was *invented* largely by agricultural economists. One might ask why the economists left and is there any reason to bring them back?

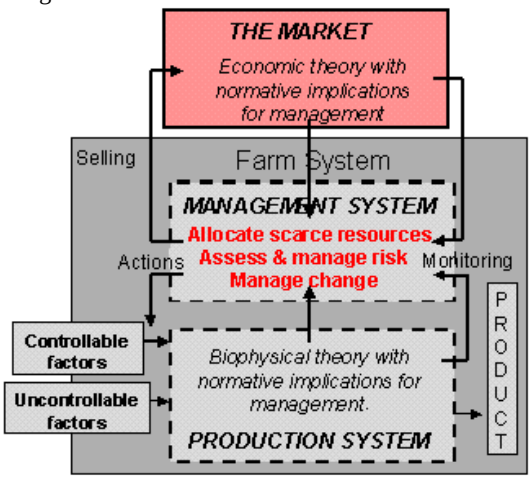

**Figure 1. The farm as systems of production and management.**

Fig. 1 is adapted from a simple model of a farming system from Sorensen and Kristenson (24). The distinction between a production system and a management system enables us to distinguish between the technical and the human, or social, element of the farm. Economics is a social science and deals with the management system as it relates to the market. A farm, so represented, suggests that in addition to the role for biological and technical science in FSR in the Production System, there is a role for economics in research aimed at supporting farm performance. But history shows that finding a niche for economics in this role is not easy. The documented struggles of agricultural economists to be effective in farm management has left clear lessons, many of which made important contributions to the idea and development of the FSR approach. Maybe it is time to ask if the reports of the death of FMR have been exaggerated, and if within a dynamically evolving FSR, a resuscitation of FMR might be desirable and feasible. This paper examines this possibility.

## The experience of agricultural economists in farm management research

### "The forerunners" - farm management research before economics

FMR began about a century ago. Although economists were not major players in the early part of this period, the efforts of agricultural scientists to aid development of the farm as a business were significant in shaping approaches to farm management problems by economists who dominated during the latter part of the period. As we discuss later in this paper, the characteristics of FMR as it was practised during the early part of the 20th century were to reappear several times throughout the rest of the century, and right up to the current day.

**Comment [BM1]:** Lisa, I think these changes avoid minor contradictions from points made in the next para.

At the beginning of the 1900s in the USA, agricultural scientists became involved in farm management as a field of study (which emerged out of the general agricultural courses that treated the whole range of agricultural practice as a single area of study (33)). These were biologists and technical agricultural scientists who knew little economic theory, but were concerned about the sociological and management dimensions of farm management (28). This was about scientists getting involved with farmers in 'commonsense' ways to facilitate improved management on farms. Agronomists were borrowing economists' techniques in order to study management practices on individual farms (33). This mainly involved scientists initiating personal interviews to collect farmers' data on income and expenses (28).

In Australia, the work in FMR in the 1900-1940 period was also dominated by agricultural scientists. In John Dillon's (9) history of academic effort in farm management, these were "The Forerunners". It was a period characterised in part by 'the lack of any specific institutional framework for farm management research and teaching" and "in the main….the absence of any analytical principles or orientation to farm management problem solving as we now understand it" (p.2).

### Enter economics

It wasn't until the 1920s in the USA (6) and much later in Australia that FMR began to move strongly in the direction of economic analysis. Farm management as a field of academic inquiry in Australia commenced around 1940 (9). According to Dillon (13), the swing to emphasising production economics as the major component of FMR training in USA, Australia and Europe, occurred as a growth out of (if not a reaction to) the initial development of FMR by professional agriculturalists with little or no background in analytical economics.

Production economics theory was the main contribution by economists to FMR. The major innovation was research on farming strategies that utilised the power of production economics theory in representing the management system in Fig. 1. In performing FMR, the assumption was made that economic behaviour of the Management System of a real farm conformed to the aggregate model of the market, conditional on key local specifications including levels of factors of production (land, labour, and capital) available to the manager, costs and prices, and the goal of the manager, generally taken as maximisation of profits. The analytical power lay in a 'marginal' analysis approach which featured the concepts of diminishing returns to an input as well as that of opportunity costs of inputs. This enabled mixes of scarce

production factors to be calculated for each enterprise that were optimal at the whole farm level (33). The Production System was represented by 'production functions' —continuous relationships of dependent production variables on input variables that were based mainly on empirical field data gleaned from published experimental results and compiled as handbooks for analysts (eg 17, 11).

The approach of early FM researchers to improved farm economic performance was to work with farmers' actual financial accounts to identify possible efficiencies, mainly through cost savings. Critical of the limitations of this *descriptive* approach, the approach of Farm Management economists was the use of production economics theory of the structure supply-demand-price relationships to identify what an economically rational manager 'should do' to optimize profits, i.e. a theoretically normative approach (28, 9). To explain this distinction in other words, the early FMR work which involved descriptions, explanations, and commonsense guidance of farm practices using simple accounting techniques was replaced by theory-based models intended to guide farm practice.

What followed after the economists had firmly staked their territory in FMR was an unleashing of theory based analytical techniques including production function estimation, programming methods, optimisation of farm input and output combinations. With the advent of computers in the 1960s, the literature was 'running a banker' with static linear programming and refinements, decision theory methods focussing on utility analysis and risky decision analysis (23).

Right throughout the frenzy of analytical developments, Malcolm (22) noted:

> "The common budgeting approaches were present through most of this time but were considered to be sufficiently straight forward and practically useful to not warrant much attention in the academic literature" (p.35).

The appointment of John Dillon in 1965 as the first Professor of Farm Management in Australia seemed to cement in place a bright future for FMR. Although he acknowledged the dangers of a theoretician-practitioner gap, he was confident that this would not become a major problem. Public sector agricultural advisory units employed economists, FMR units were set up and Dillon's department at UNE achieved academic eminence (McCown, in preparation).

However, soon the cracks began to appear. It didn't take long for some to conclude that things were not going according to expectations: the bad news was that FMR with a economic theoretical orientation had become more focussed on theoretical and methodological issues and of less and less relevance to the solution of practical farm management problems. The crisis has been well documented in both Australia (22) and in the USA (20). It started in the USA as early as 1957 (20):

> "..by the late 1950s, much modern USA farm management began to look like a sub-field of production economics which is itself a part of economics, without the multidisciplinary breadth required to handle the problems which arise for farm managers out of technical, institutional and human change" (cited in 28, p.293).

Criticisms followed some time later in Australia. In 1976, the then president of the Australian Assocation of Agricultural Economists judged that 'FM barely existed as a branch of agricultural economics providing advice which influences the decisions of farmers" (27, p.138) and that the techniques of FMR were "a job-lot of techniques mostly of a programming nature…producing a few unthinking technicians but not producing many useful farm managers' recommendations of a general or specific nature" (p.139). Note that failure was not from a lack of trying to be more effective in the management of real farms (eg: the failed use of LP in Farm Management Service Laboratories (5,10)).

It was not long before Dillon (13) began to question if the economic theory could be relevant to any real world problems.

> "…FM based on production economics has lost touch or must inevitably lose touch with farmers' needs and the practicality of farming because of its emphasis on logically attractive but largely inapplicable theory" (p.11).

While Dillon was by no means alone in his crisis of confidence in production economics, his remarks are particularly telling considering it was only a decade earlier that he was championing the techniques of production economics.

What went wrong? Malcolm (22) provides a comprehensive critique of the concerns of a number of Australian economists. Dillon (13) clearly set out the difficulties faced by economic researchers in representing real-world farms in theoretic models:

> "There is no conceptual difficulty in formulating static production economics in terms of a utility-maximizing criterion, nor in conceptualizing its logic for non-physical processes. The difficulty lies in *application*.
>
> First, data are not available to be able to specify the relevant production processes (both physical and non-physical) to any significantly relevant degree - particularly if we recognize the *uniqueness of individual farms.*
>
> Second, the farm system is *dynamic*, not static, both in the broad as a purposive organization in a *changing* environment and also through the pervasive role of biological time-dependent growth processes in its technical subsystem.
>
> Third, even if data were available to specify the required production processes adequately, the task of analysis even under perfect information would be both *too complex* and too costly for either farmers or computer-aided professionals. "Non-optimizing" mode of behavior has to be used.
>
> Fourth, the problem of *uncertainty* has to be handled. Again this is pervasive in agriculture due to the stochastic vagaries of climate and markets especially, but also because of uncertainty about technology, policy and people. While techniques have been suggested to handle such uncertainty, their cost on a thing approaching an individual farm basis makes them impractical.
>
> Fifth, even if all farmers faced the same production functions and the same judgements about the probabilities, they would still have *different preferences* and so need different prescriptions for utility maximisation across their *individual multiple goals"* (p.11).

**Systems approaches: the 'needed reorientation'**

As those involved in FMR came to realise that traditional production economics could not deliver the goods for farm management, some started to cast around for an alternative that might do so (22). Dillon (12, 13) declared that systems analysis was the "needed reorientation" – "at least until the next revolution occurs!" (p.12).

Dillon's proposal for the new was based on his assessment of the old that there had been inadequate distinction between farm management (ie the farmer's activity) and farm management (ie the professional activity).

Dillon (13) believed that FMR needed two major reorientations:

i) it should recognise only a professional responsibility to the farmer, and
ii) it should view the farm as a dynamic, open, stochastic, purposeful social system.

Dillon was writing at a time when perceptions were growing that 'station based' research was not as relevant to local situations as was needed to ensure the generation and uptake of improved practices amongst small-scale farmers in lower income countries (LICs). This stimulated what became known as FSR into mainly international agricultural research centres in the 1970s and 1980s. Many early FSR pioneers in developing countries were agricultural economists who specialised in farm management (14,28). Like some of their counterparts in the USA and Australia, these economists struggled to adequately deal with the problems of small-scale farming using their theoretic models imported from their FMR backgrounds. The 'gap' between theory and practice in LICs was more exaggerated than in countries such as Australia and the US. According to Norman (28), such struggles delivered unexpected insights about the management system. Instead of assuming that unfamiliar indigenous management behaviour and technologies in these farming systems did not qualify as 'economically rational', it was realised that the vast majority of farmers were rational (ie sensible) in their practices and that they had an

intimate understanding of their production environment and worked well within their production constraints. This led to a new found respect for the role of farmers in evaluating technologies and undermined confidence in the traditional FMR analysis tools. Norman (28) said:

> "The dominant feeling of those who were engaged in these technology evaluation exercises, most of them agricultural economists, was dissatisfaction with the process that prevailed at that time for developing and evaluating technologies. This was particularly true in less favourable and more heterogeneous production environments. One very significant conclusion was that conventional economic criteria did not ensure identification of a relevant technology" …."Progress in identifying technologies that were relevant only occurred when trials were first implemented on farmer's fields with the non-experimental variables reflecting farmers' practices, and farmers' criteria were used in the evaluation process"(p.295).

Thus, the foundations for the development of FSR had been laid. The admission that the struggles of the early FSR economists could have been avoided by paying more attention to the lessons of the past is noteworthy (eg 28, 20).

> "..there has been much reinventing of the wheel in developmental thinking as ….agricultural development economists have….rediscovered FM. Lessons gleaned from the historical development of the field of FM and agricultural economics have been neglected" (cited in 28, p.296).

FSR approach evolved from these beginnings based on the premise that the problems of farmers first had to be understood. Consequently, solutions to their problems had to be based on a proper understanding of their household and production environments, including biophysical and socio-economic dimensions, and this understanding was unlikely to be obtained without the involvement of farmers (32). Some (but not all) characteristics of early FMR began to reappear. Examples include adopting an interdisciplinary method, nurturing relationships with farmers and using an interactive procedure for FSR related work (28). Although, over time FSR embraced a mixture of approaches that were prominent at different stages in the evolution of FMR, according to Norman (28) the characteristics of what the farming systems approach has become in the 1990s were analogous to those of the pre-economics era of the FM approach, i.e. about 1900-1940

> "Philosophically, the 'current' farming systems approach, as practiced mainly in low-income countries, has much more in common with the 'earlier' farm management approaches in the high-income countries"(p.297).

Dillon's call for recognition of the farm "as a purposeful system" opened up new ways of working for economics. As the social scientists on the FSR teams, over time they took a much 'softer' (qualitative) approach than they did in FMR, acting as the interface between the scientific research and farmers. Further evolution of FSR led to developments in:

- eliciting farmers attitudes, opinions, and contributions in an inexpensive and systematic manner;
- designing, implementing and evaluating on-farm trials involving farmers themselves;
- addressing sustainability issues (28).

With these developments in data collection, processing and evaluation, FSR began to distinguish itself from the early FM approach (28). Further developments in the 1980s, particularly those associated with the increased activity of sociologists and anthropologists in more explicit exploration of the links between farm and family, saw a further 'softening' of economists. The key evolution in the research compared to earlier FSR was incorporation of a more participative element, bringing about a change in the interactions between farmer and researcher (7,24). While experiences in the early FSR involved much more interaction between farmer and researcher on the choice of technologies already developed, advances in participative approaches moved interactions into the design of technology. The latter has now become a focal point of the FSR approach and marks one important difference from the conventional FMR (28).

**FSR in Australia**

While agricultural economists were leading the charge on the FSR front in the early 1980s in LICs, FSR was largely ignored by researchers in places like Australia (24). This was despite salient contributions of Australians to early FSR development internationally. Although the ideas of FSR eventually diffused into Australian agricultural research in various ways (31), agricultural economists have not been prominent in Australian style FSR, which has had a highly technical focus. In the main, scientists have worked with farmers without a social scientist involved. Malcolm (23) poetically offers a perspective on this:

> ".. farming systems approaches would have to prevail. It would be difficult, and progress would be slow……. most academic workers in farm management economics had decided that this was a rough shed and it was a fine day for travelling" (p.13).

In recent years, there has been widespread establishment of 'farming systems' research across Australia, although there is little uniformity in approach (31). This diversity may represent a search for appropriate models of FSR for Australia, but overall, Australian-style FSR has been only vaguely defined and there appears to be little reference to international literature involved in the spectrum of new FSR programs and projects (31). McCown et al. (25) distinguished between 'farming systems research' and 'systems research about farming.' The 'hard' mode of the latter utilizes modelling of biological and/or economic aspects of farming.

Agricultural economists were among the first to see the potential of simulation models which entered agriculture from Operations Research (8). Anderson (1) provides a comprehensive review of simulation in agricultural economics as a way to incorporate dynamic elements of the farm system and overcome the simplistic treatment of complex systems via production functions. But whatever simulation did for the realism of models of the production system, the result was not increased use and usefulness of economic models in farm management practice (15).

> "Despite the early, illuminating experiences of the agricultural economists with farm systems modelling, this work proceeded apace as computing facilities and accessibility improved through the 1980s, often repeating the mistake of believing the partial systems modelling being done was about the operation and management of a farm business"(22, p.48).

It is worth noting here that although economists in LICs were turning to less quantitative approaches, systems simulation and other modelling methods were still judged by some as having a potential role in the socioeconomic aspects of FSR (2). Budgeting was recognised as the stand out approach mainly because of its simplicity and flexibility. While linear programming was also valued, its use in LICs, along with systems simulation was limited, at least up until the mid-1980s, by difficulties in securing access to computers. But Collinson (7), reviewing the situation 15 years on, while acknowledging that the methods of FMR during its various stages have played an important role in FSR, concludes that modelling is too "hands off" to be effective in research with farmers. He suggests that the greatest contribution of the various modelling approaches that have come out of FMR, have been in understanding, particularly in the *ex ante* evaluation, of the impact of interventions on the existing system. Much earlier Dillon et al. (14) had similar view, claiming that computer modelling techniques such as systems simulation and programming can be of real value in helping to define both research station and on-farm priorities.

Similar views have been expressed in Australia. Systems simulation was seen as providing a "general planning facility for 'typical' farms which advisory personnel can use to 'develop a feel for management action" (22). This also paralleled the conclusion about the value of LP in management. In an *ex ante* role, many of the analytical approaches coming out of the FMR (eg elaborate quantitative techniques such as mathematical programming) that had a disappointing run in the real-world management of farms have found effective homes in other forms of agricultural economics research. One well-documented example is the experience of agricultural economists using the linear programming model MIDAS (19,26) in multi-disciplinary research teams in the WA Department of Agriculture. The developers claim that the biggest impact of MIDAS has been in influencing the biological research activities of other researchers who are attempting to serve or influence farmers (29). Other analytical approaches have not been as successful in finding a niche, eg expected utility models (30).

In Australia, systems simulation probably marked the last major development in Farm Management and by the late 1970s FMR in Australia had largely run its course (22).

> "Most of the trails blazed in the long boom of activity in academic farm management since 1940 had been followed at some length…". "…over time emerged an increasingly commonly-held unease, and occasionally conviction, that these were trails which if followed, soon led from the complex and difficult whole-farm pastures of plenty to simpler and easier analyses characterised by incomplete and inappropriate disciplinary balances and resulting in work which was not really about farm management" (p.49).

**Lessons for Australian FSR**

Although FMR has evolved considerably over the last 100 years, Norman (28) concluded that it never fully reflected what it should be in the USA and has fallen short of its potential to guide farm management practice. In Australia, Malcolm (22) similarly concluded that the emphases on production economic estimation of resource activities, on linear programming approaches, on systems simulation, utility analysis and formalised probability analysis had been of virtually no direct use so far as actual decision making on farms went.

So what is the outlook for economic research in having an impact on the management of real farms in Australia? More specifically, what opportunities exist to narrow the gap between management of farms (ie the farmer's activity) and Farm Management Research (ie the professional activity)? The various failings of economists in FMR have not been in vain because they permit us to learn from them (13,22). If we act on the learnings from the past, the future need not be bleak. Recent funding of FSR in Australia may provide an opportunity for reinvention of an economics input to this area that will prove more effective than earlier FMR efforts.

In the US, there are suggestions that the FMR profession has come full circle (28) with FMR having made important contributions to the development of FSR and the FSR in turn potentially contributing to FMR. In Australia, as has been suggested in the US, there are similar opportunities for FM economists to reinvent themselves in FSR projects in Australia. Whether we classify such economists as FSR or FMR economists is not an issue - essentially we a talking about a convergence of the two approaches to impacting on farm management practice. We note Norman's (28) comments on this matter – that is, these developments can be called an expansion of FSR influence or a renewal of FMR, but "such a debate would be both unproductive and sterile" (p.298).

In thinking about the future of FMR/FSR in Australia, we should be reminded of Johnson's (28) comments about the failure of FSR in the LICs to learn sufficiently from the FMR experience:
"Tragically, some important wheels have not been reinvented or rediscovered while some wheels demonstrated historically to have flat sides and faulty bearings are being reinvented"(p.296).

In Australia, it is ironic that despite 50 years of methodological and analytical developments in FMR, the simple budgeting techniques used right from the early era of FMR, that "were considered to be sufficiently straight forward and practically useful to not warrant much attention in the academic literature" (Malcolm 1990 p.35), have stood the test of time.

> "Throughout this time management professionals, and the managers of farms, battled on with the simple budgeting techniques whose chief virtue was that they were general enough to allow a comprehensive picture of all the important aspects of the problem and the full ramifications of the solutions(s) to be weighed in the decision. Indeed the validity of the budgeting techniques have not only stood the test of time but their usefulness and analytical power have been enhanced enormously in modern times by the computer spreadsheet. In particular, the spreadsheet enables the risks, time and dynamic aspects of a problem to be analysed more practically and fully than ever before" (p.50).

Despite its shortcomings in theory-based models, it has been widely agreed that production economic theory has been highly valuable to farm management problems (13, 2, 21).

> "In the days when production economics was king, little emphasis was placed on the human, technical, financial and management aspects of farm production, or on the operation of individual businesses. This led to more workers in academic farm management losing relevance to practical farm management. However, the enduring legacy of production economics is the economic way of thinking about problems. There is a definite widespread relevance of a couple of key, commonsense principles, about a bit more of this (input, output) and a bit less of that (input, output), in order to make a bit more in total from limited resources." (21, p.2).

Makeham and Malcolm (21) argue that it is through the spreadsheet budgeting approach that production economics can live on:

> "Despite limitations of the relevance of formal production theory to farming practice, key ideas of production economics such as diminishing returns, substitution, equi-marginality and opportunity cost, fixed and variable costs, and the key concept of production surfaces, remain sufficiently valuable to farm management to be the subject of research efforts, and can, to some extent, be incorporated in the spreadsheet-budgeting approach. The computer spreadsheet enhances the potential analytical uses of farm activity budgets and could have a role in giving production economic principles greater relevance to real farm management" (p.368).

In Australia, the success of the budgeting approach endorsed by Makeham and Malcolm (21), appears to boil down to the same ingredients that made the early FMR era effective in farm management practice and gave the FSR movement effectiveness. The first is the budget's broader coverage of the elements of a problem relevant to a decision maker. Secondly, it enables involvement of the decision maker and thirdly, customisation of the problem representation. Makeham and Malcolm (21) said that the budget enabled incorporation of the "management-human element through the spreadsheet model being specific and unique to each situation, incorporating intimate knowledge of possibilities and constraints, and decision makers' preferences and beliefs, in the activities analysed and the numbers put in the budgets"(p.368).

In idealising the FMR professional as a 'goal adjuster', Jack Makeham had considerable success in bringing farm management professional activity and farm management practice closer together (22).

> "A role of professional farm management advisers is as 'professional goal adjusters'. Farmers might state definite objectives but might not see that their physical and managerial resources do not match their wishes. It is essential to find out if the product markets and the resources…and skills are compatible with these goals…….. Given this, however, the adviser cannot know more than the farmers do about what is 'good' for them." (21, p.17).

This significance in enabling meaningful interactions with farmers is central to the remainder of this section.

One way of thinking about the lessons from history is that FMR economists ran into the problem of not seeing farm management practice from the 'inside' of the Management System (Figure 1), that is - from the farmer's viewpoint. The elements of farm practice from the inside are – a) that farmers' management practices are *social*, i.e. subjectively purposeful, and b) are *local*, peculiar to that farmer's Production System (Figure 1). As discussed in McCown (24), both social and local are embodied in the term *situated*. Situations are *experienced*, and a farmer's management practice evolves with experience, that is - they have a meaningful history. Because farmers learn from experience, they begin to develop knowledge of consequences of actions. This accumulation of expertise means that even though situated farm management practice becomes enormously complex in terms of scientifically describable mechanisms, the complexity is not necessarily a problem for the experienced farmer on that farm.

However, from the 'outside', that is - the viewpoint of the economist, the picture is very complex and scientists and economists have tended to assume that scientific assistance, incorporating theory-based models, was needed to help farmers in dealing with farming systems complexity, when in fact complexity has often not impaired farmers perceptions and actions.

Pannell et al. (30) outline a similar explanation for the disappointing history of whole-farm linear programming optimisation models in serving farmers. At first glance, the view of farm management from the outside only takes in the operations performed by the farmer. However, for FMR to be relevant to real world farm practice, economists need to better appreciate practice from the 'inside' and broaden the research approach to include the farmers 'inside' view. Many normative, theory-based models were doomed to fail in making an impact on management practice because they used some notional farmer goal as the premise for analysis, that is - they made assumptions about the 'inside' view, and no amount of elaboration of views from the 'outside' would improve the situation. Theoretical economic models, no matter how complex they got, missed the mark because they focussed on the management of the technical subsystem of a farm (13) using theory which deals with the aggregate (as opposed to individual) behaviour of decision makers in the market. Many 'whole farm' models (eg of the type discussed in (3)) were only partial because they were simply complex technical subsystem models. Also, in these models the idealised economically rational Management System was made to conform to theory of the market, rather than the individual farmer.

The participatory aspect of FSR offers a way to combine both 'inside' and 'outside' perspectives. 'New' possibilities emerge from revisiting the literature, which suggests that the budgeting technique had been so valuable because of the types of interactions with farmers that it permits. Using the approach described by Makeham and Malcolm (21), budgeting facilitates the incorporation of both inside and outside perspectives.

History has shown that economists seeking to be effective in the management of real farms need to seek new ways to be meaningful to those inside the management system. FSR that is engaging challenging problems of unsustainable farming systems might benefit from the power of economic theory in models. But if this is to be tapped by farmers, it would seem that economists must use their models differently. If instead of an overly simplistic representation of the Management System that is not meaningful to the farmer, economists work with a process of dialogue and interaction with farmers, the management system is already represented by the participation of the farmer in discussion with the scientist. A farm manager's view from the 'inside' is holistic as regards the interests of the farm. An important learning from the use of simulation models in discussion with farmers (18,25) is that farmers are not expecting or looking for comprehensiveness in treatment of their farm. More than anyone, they know that is not possible. Instead they are looking for evidence that the interaction might deal helpfully with some aspect of the environment or of an action that is difficult for them because of uncertainties which makes decision or action problematic. Because experience tends to reduce uncertainties, the benefits of intervention that elucidates situations is most important in periods of change. But when the climate is highly unstable, the value of experience is much reduced. Models that structure climatic uncertainty using simulated historical 'experience', and especially that which uses current climatic forecast information have been proved valuable to farmers in model-aided discussions in testing and modifying their goals and plans (18).

Such a change in the way a model is used amounts to a paradigm shift in research. Using Oquist's typology of research described in McCown (24), this represents a shift from normative 'Policy Research' to 'Action Research'. But an important characteristic of Oquist's typology is that Action Research presumes and builds on Policy Research. The output of policy research is knowledge to guide best practice, based on theoretical possibilities and limitations. This corresponds to much of the economics work done in FMR. Action research is also concerned with the production of knowledge that guides best practice but instead of guidance being based solely on reference to theory, it takes the latter as a reference point, along with the experience of the farmers, and searches for a 'best practice' in the practical situation. In action research, modifications in farm practice occur *as part of* the research process, rather than *subsequent* to the research as is the case for policy research.

Economists who aspire to FSR in Australia are at risk of falling into the trap of the early FSR researchers in LICs. That is, believing that the relocation of research to the farm was automatically equal to *situated in farming.* McCown (24) notes that early FSR workers tended to do "portable policy research" rather than action research. Although research in Australia has moved onto farms (eg GRDC Farming Systems Projects), this does not guarantee enhanced relevance to farm management practice. The majority of the relatively small group of Australian agricultural economists attempting to influence the practices of

farmers work in 'policy' mode, leaving the interface between the research and the farming problem to someone else, mainly extension agencies. However, while there are signs of change, it is no wonder that economists operate in the 'policy' mode of research. Truly participatory action research is hard work, time consuming, stressful, and not adequately rewarded by research institutions.

**Getting on with things**

Farmers are accustomed to managing complexity and generally get by very well with little assistance. Pannell et al. (30) explain:

> "Despite the apparent difficulties…farmer's decisions …are very good. They are not perfect but they are usually near enough to the theoretical ideal for their particular circumstances to obtain most of the potential benefits. They are helped in this by the forgiving nature of many agricultural decisions; often there is a range of strategies around the optimum which give near-optimal levels of profits" (p.2).

And, given the demonstrated success of the approaches outlined by Makeham and Malcolm (21), based around budgeting techniques, what more is there for the contemporary FMR economist to do? Many scientists have thought that the answer is "not much". As they did at the turn of last century, non-economist scientists have picked up budgeting tools, attracted by the simplicity and demonstrated value in farm management practice, dispensing with the need to employ economists. Budgets have been used by these scientists with varying degrees of sense and nonsense (16). Malcolm (22,23) has written of the dangers of this situation, and of the 'amateurish' approach to FMR that has pervaded the profession with errors of the past creeping in through both unreflective scientists and economists. Budgets might be simple tools but they require sophisticated thinking.

There are important things for economists to be getting on with. Although farmers do very well in day to day management, farming systems complexity does become an issue when a farmer is a novice regarding a practice or when a relationship between action and outcome breaks down. All it takes to make an expert into a novice is a radical change in technology or strategy (24). The long-term nature of ecosystems degradation is an example of action - outcome breakdown. In the US, sustainability issues have prompted the interest in 'reinventing' FMR based on FSR methodologies. In Australia, we also believe that issues of ecosystem breakdown open up substantial opportunities for FMR. Despite its disappointments in FMR and Decision Support Systems, recent experience using complex theory-based simulation models in situated 'what if?' analyses and discussions shows that this can be an effective way to enhance farmers' decision making and to facilitate discovery learning. Although there is no question of the merits of on-farm experimentation, there are important classes of problems that on-farm experimentation cannot address adequately, e.g. (a) problems in which outcomes of ameliorative action are highly contingent on weather, which is very uncertain and/or (b) long term effects of management on the rate of soil/landscape degradation (or rehabilitation) for which the required duration of experiment is infeasible. In the discussion of ecological sustainability, the essential difficulty is that of making sense of necessarily short on-farm experiments (24). In experiments, as well as in real farm systems, the feedback to farmers about the appropriateness of actions in slowly evolving environments is far from straightforward. Many causal inferences are possible, and only experimental reduction can sort out the many competing explanations. Unfortunately, long-term farming system problems do not lend themselves readily to reduction, leaving knowledge creation to farmers who construct knowledge out of what they experience. Real farm decision environments lack closeness between decisions and meaningful feedback. This is a problem when the feedback cycle is longer than the decision-making cycle.

Research in APSRU's FARMSCAPE project since 1993 has shown that the combination of historical weather records and well-developed simulation models offers significantly enhanced interpretation of on-farm experiments (25). Simulation-aided discussion with farmers as part of participatory action research can be highly valued by participating farmers, their advisers, and researchers. Situated, simulation-aided discussions essentially fast track management experiential learning by substituting simulated systems for real ones. Increasing complexity of both external environments and internal dynamics of organisations have stimulated a new interest in new computer-based modeling and simulation tools in the general management literature. For example, Bakken et al. (4) have used computerised simulation models with managers from manufacturing and service industries. They found that simulation helped managers

become more aware of their own mental models and provided 'virtual worlds' in which assumptions, relationships, and outcomes can be tested, thereby shortening the feedback cycle time in situations where delays are inherently long. A management simulator in this role is a learning tool that allows managers to compress time and space, experiment with different strategies, and learn from making rounds of simulated decisions.

It is interesting that Bakken et al. (4) note that despite the recent advances in simulation and other tools that have made 'virtual worlds' more powerful, *with the exception of spreadsheet analysis on personal computers*, little has been made of virtual worlds for improving managerial practice. This prompts another way of thinking about budgeting techniques.

FARMSCAPE's effectiveness stems from the combination of participatory action research and hard systems models. The fact that these complex systems simulation models and their simpler DSS derivatives failed in the past, is a reminder that the crucial factor in the success of complex models is whether they can be seen by the farmer as sufficiently *situated* to be taken seriously in his/her planning process (24). This was a key factor in the downfall of earlier attempts. The FARMSCAPE project uses a production system simulator in discussions which includes 'economics' as farmer's gross margins. FSR methodologies have breathed new life into techniques of the past. If simulation is one such example, we must rhetorically ask what are the opportunities for other economic theory-based approaches to enhance farm management discussions with farmers?

Another development which greatly supports research carried out in the participatory action research paradigm is case study methods. Case study research, viewed as a research method rather than methodology, can play a role in enhancing FMR. The long prevailing approach of 'policy' type agricultural economics research is the use of the 'representative farm' in the evaluation of technologies and management options. The problem with this is that representative farms, based on statistical averages, are artificial constructs. The representative farm is not a real farm and does not allow for interactions between economists and farmers around a real management system – that is, it cannot be situated, or seen from the 'inside'. Malcolm (23) supported case study methods to complement farm management research

> "…analysis of the effects of research findings and policy changes on the situation of the representative, but unreal, farms would be enhanced by some parallel, real, whole farm case studies because representative or average farms do not actually exist" (p.24-25).

Scapens (1990) described the methodological basis of case study research as being closer to experimental science than with statistical surveys. This means viewing case study research as a method by which theories are used to explain observations. The objective of the individual case study will be to explain the particular circumstances of the case. Case study methods allow economists to better understand farm management practices in a specific set of circumstances.

**Conclusions**

Since the first professional farm management researchers took an interest in farm management practice, the fundamental problems of farming in Australia have not changed much (the exception being the important addition of ecosystem degradation). However, the techniques and approaches used by economists to analyse them have evolved considerably, although this did not amount to improved effectiveness. Jack Makeham's (21) 1968 assessment of the major challenges to the farm manager are still highly relevant today, that is - (a) how to incorporate new technology profitably into an existing business organization; (b) how to be sufficiently flexible, mentally and financially, to adjust resource management to meet both changed economic circumstances and widely varying climatic conditions. These comments, considered alongside a survey of what has endured after the dust settled from the fall of the FMR era suggests that we could be excused for hauling out the adage "the more things change, the more they stay the same". An update of John Dillon's (9) history of FMR might well include an additional section entitled 'Back to the Future'. To answer our question posed in the introduction of this paper – yes, there is a reason to bring economists from the background to the foreground of this convergence of research and farming practice in Australia. There are opportunities to do this using 'hard systems' tools, such as systems simulation, in new ways through participatory action research. The learnings from the FMR era and farming systems researchers in lower-income countries provide important guidance for the conduct of

research that is directly relevant to real farm management problems. So, to finish on Malcolm's (22) closing remarks: "For those so inclined, there is plenty to be going on with".

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